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Ambrose Swasey

Builder of Machines, Telescopes, and Men

By J. J. NASSAU

"You know, it wasn't so long ago since Galileo was put into prison for saying that the world was round and that the sun was the center of the Universe," once said Ambrose Swasey. "That was not so very much before my time, only one hundred and twenty-five years before the birth of my grandfather whom I remember well. People now do not know much more than they did then." And yet people do know more on account of Ambrose Swasey for he built giant telescopes that pierced the depths of space and devoted his talents to science and engineering, leaving a lasting influence upon his age. On June 15, 1937, he died, a great task completed, four score and ten years of noble living.

Childhood

The Swasey family have been residents of New England since 1686. They immigrated to this country from England. Ambrose Swasey was born on December 19, 1846, the son of Nathaniel and Abigail Peavey Swasey and was the ninth of ten children. Nathaniel Swasey, a progressive farmer of Exeter, New Hampshire, was sufficiently skilled in the mechanical arts to make his own tools and wagons, and young Ambrose must have learned to do things with his hands on the farm. The study of ancient history and astronomy occupied the intelligent interest of this New England farmer. From his father, Ambrose doubtless got his trait of intellectual curiosity. From his mother, he inherited his cheerful disposition and his vein of quiet humor with which for years he delighted his associates.

There were no mechanical toys when Ambrose was very young but he soon learned to make his own. Mother's old spinning wheel and his jack knife helped in making a flax wheel. The old attic was his workshop and there he set up an improvised lathe. Then he made a working model of a mowing machine which is still in existence. Boys on old New England farms all had duties and Ambrose was in charge of the sheep and lambs which he loved and gently cared for. When Eben, his next older brother and close companion, was in college, young Ambrose took him to school every Monday morning and called for him on Friday afternoon, often driving through heavy snow drifts.

The brothers got into their share of difficulties. When Abraham Lincoln went to Exeter to visit his son Robert who was attending the

Academy, Eben and Ambrose thought it fitting to celebrate this unusual event by building a bonfire. This they did on a hill back of their house and nearly succeeded in burning the old homestead.

Apprentice—Meeting W. R. Warner

"Although all my brothers and sisters went to academies or colleges, my only schooling came from the little country grammar school and lasted only two or three months," said Swasey. But he received half a dozen of degrees from leading Universities, helped to shape higher education in America and led in the development of scientific and engineering research.

He made his final decision upon a career in 1865 when he told his father he would like to learn the machinist's trade. Up to that time the hope of the family was that he would follow his brothers and sisters to some institution of higher learning. But he went to a newly established machine shop in Exeter. A year later, another young man of the same age and as eager to learn as Ambrose came from Boston and started to work in the same shop. This young man was Worcester R. Warner. The two enthusiasts soon became warm friends.

As Ambrose started ahead of Worcester in the apprentice work, he finished first, and then to widen his experience he went to Paterson, New Jersey, to enter the employ of a locomotive firm. He soon found the work unsuited to his inclinations and perhaps, too, a bit of homesickness hastened his return to Exeter. Once again the two young friends spent the winter working together in the shop, living and studying together, and planning for the future. This was the development period of two astonishingly parallel characters, not in any sense identical but rather, complementary.

It may be said that the spring of 1869 marked the beginning of their life-long partnership, for at that time they wrote letters to four companies seeking positions as machinists. The result was four offers. As was to be expected they made the same choice. After their first day's work at the Pratt and Whitney shops in Hartford, Connecticut, Warner remarked to Swasey, "Well, Ambrose, we have a very difficult job. There are three hundred young men ahead of us." But soon they attracted attention by their special abilities in solving mechanical problems, and the number ahead of them diminished, for both were given important positions which they held until they left the employ of the company eleven years later to start out independently to establish a business of their own.

Cornell Offer

The training he received on his father's farm, the experience he gained in the Exeter machine shop where men found joy in good workmanship, the long hours spent in his room at night studying books on machines, all showed their first fruits soon after Ambrose Swasey joined Pratt and Whitney. At thirty-two, he was made superintendent

of the gear cutting department. A year later, through study and development at his home nights, he produced a beautiful piece of mechanism, the epicycloidal gear engine. It was constructed in the shop under his direct supervision and proved to be a success. His inventive ability, his breadth of knowledge both theoretical and practical must have been recognized beyond the limits of this New England shop, for in 1879 he was invited to succeed John E. Sweet, professor of Practical Mechanics at Cornell University. The invitation surprised him. He underestimated his ability, self-training, and experience, and he declined the offer.

First Patent

Being in charge of the gear-making department was not sufficient occupation for the energetic mind of the young machinist. He found time to invent and obtain a patent for an improved protractor, an instrument for laying and measuring angles with great exactness. It is significant that his first patent was in that direction, for mechanical accuracy became one of the major factors in his great success as well as a deeply rooted phase in his character. He commenced early in his career to pay special attention to the subject of gearing. Besides the epicycloidal milling machine, he invented a new gear-cutting machine for generating and at the same time cutting the teeth of the spur gears. Many other patents followed, the majority of them for turret machines and optical sighting instruments. Today an important division of Mr. Swasey's achievements is the design of military instruments of precision, including the invention of the depression Position Finder for seacoast defense fortifications, used by the United States Government for a number of years.

In his scientific writings one may easily see his profound understanding of the evolution of thought in mechanical engineering as well as astronomical technique.

The Cleveland Firm

In 1880 Warner and Swasey left Hartford to enter business for themselves having, for capital, eleven years of joint savings. Their first location was in Chicago, but later they felt this was too far removed from the industrial east, and they decided to move. On July 8, 1881, there came to Cleveland a new citizen, a young man with a striking face, beaming eyes and the picture of health, Ambrose Swasey, the machine tool builder. His partner had left Chicago some months earlier to supervise the construction of the shop they had planned for this city.

There was little difficulty in obtaining orders and the new firm concentrated on a policy of establishing the highest standards in their products, whether in machine tools, instruments of precision, or telescopes. The two men were so absorbed in the designing and making of machines, and the trust in each other was so great that they did not bother to draw up a written agreement of partnership until 1900 when they incorporated as the Warner and Swasey Company.

Early Astronomical Work

Astronomy had been the delight of Worcester Warner since early youth. His interests inspired his young friend Ambrose and soon this subject became an added bond between them. They had talked and

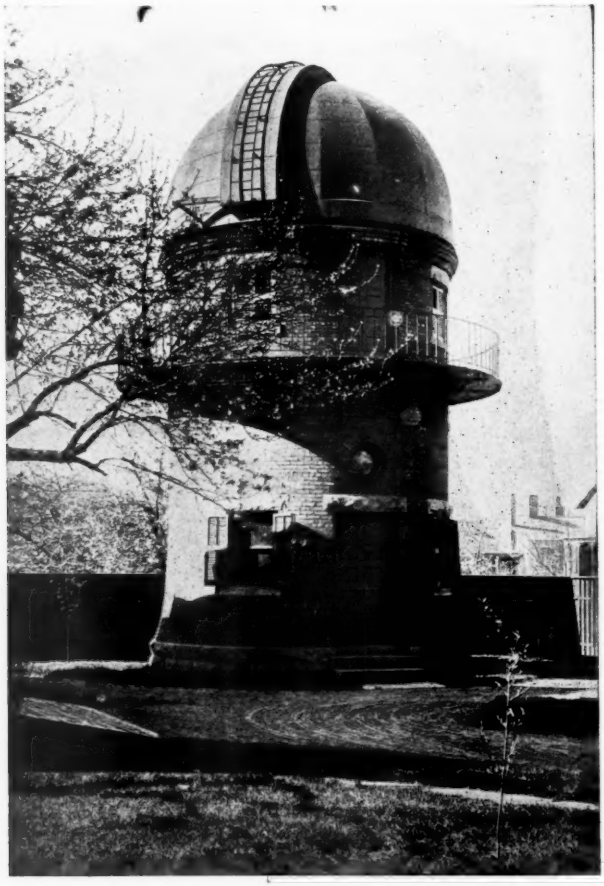


Figure 1
Observatory of Mr. Warner and Mr. Swasey
at their homes in Cleveland.

thought and built small instruments for many years. It is not difficult, therefore, to understand that, soon after they had established themselves in business, they had designed a distinctly improved mounting. This first telescope, a nine and one-half-inch refractor, was sold to Beloit

College upon the recommendation of Professor Burnham. A year later in 1882, they constructed their first big dome, forty-five feet in diameter, for the Leander McCormick Observatory of the University of Virginia.

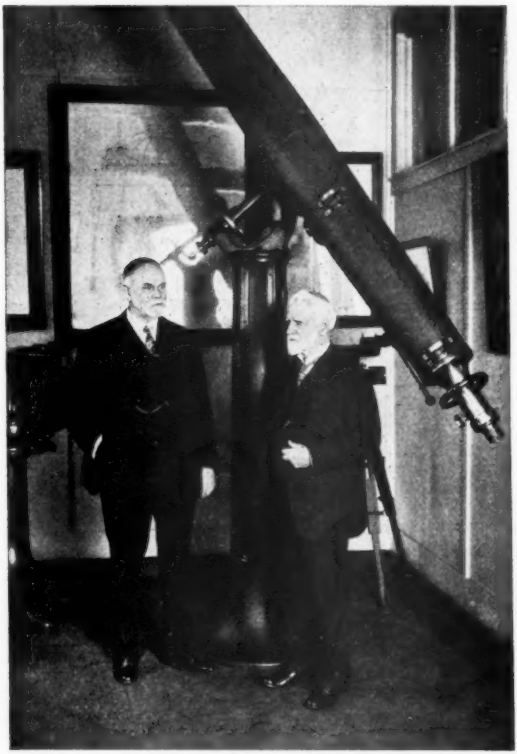


FIGURE 2
W. R. WARNER AND AMBROSE SWASEY AND THE BELOIT TELESCOPE, THE FIRST ONE THEY CONSTRUCTED.

The tremendous progress in telescope making may be realized when we recall that the largest telescope in the world in 1845 was a fifteen-inch refractor. Harvard College and Pulkowa shared the honor of such a telescope. The race for larger instruments may be said to have commenced about that time. The two young partners had much to do in bringing America to its undisputed supremacy.

LICK TELESCOPE

When the Lick trustees were preparing for the largest and most powerful telescope in the world, according to the wishes of James Lick, plans and bids were asked for the mechanical parts from all the telescope

makers of the world. This was taken as a challenge by the two visionary and energetic manufacturers. Their knowledge of astronomy was limited and their experience in telescope making went no farther than the nine and a half-inch instrument for Beloit College. This new venture was a problem of the first magnitude even for the most experienced engineers in this field. The undertaking called for an instrument to be used not only for visual work but photographic and spectroscopic as well, new functions at that time. With their characteristic thoroughness and team work, the two partners in a few months submitted plans, and theirs was the highest bid submitted. The design in which they included for the first time polar and declination axes of steel, ball bearings, and improved counterbalancing was judged to be the best, and it received the award.

On November 14, 1887, a year and a half later, Mr. Swasey left Cleveland for California to supervise the erection of this magnificent instrument. On December 31, Alvan Clark placed his masterpiece, the thirty-six-inch objective, in the tube of the telescope. The astronomical career of the Lick telescope began on January 3, 1888, when Captain R. S. Floyd, president of the Lick trustees, Alvan Clark, J. E. Keeler, and Swasey observed through it, first Aldebaran and later the Great Nebula in Orion.

Period of Large Telescopes

Soon after the completion of the Lick telescope came the building of the new mounting for the 26-inch refractor and the meridian circle for the United States Naval Observatory.

When in 1892 the 40-inch Yerkes was projected there was no doubt as to the style of mounting, or as to the makers. They received the contract for the telescope and the 90-foot dome without competition. The result was this world-famous instrument which combines beauty and precision, strength and delicacy of motion, characteristics close to the heart of its designer.

The trend in astrophysics, particularly at the beginning of the century, brought reflecting telescopes into great prominence and Ambrose Swasey took an active part in their design and construction. It was his engineering genius that made possible the improvement in the mounting of the secondary mirrors which enables one to change from the Newtonian to the Cassegrainian arrangement with little danger or loss of time. This was first done for the 72-inch reflector of the Dominion Astrophysical Observatory.

The completion of the mounting for the 82-inch MacDonald telescope coincided with his eighty-ninth birthday and it was very evident at that time that he was proud to see that the men whose skill he had helped develop were doing such creditable work.

For over eighty years the work of the construction of large telescopes and the figuring of their optical parts has been done in America. The only non-American feature which astronomers in this country needed

was the glass from which lenses and mirrors are made. Ambrose Swasey felt that the United States should be able to make such glass at least for large mirrors and spoke to Herbert Hoover, then Secretary of Commerce. He suggested that the Bureau of Standards might undertake

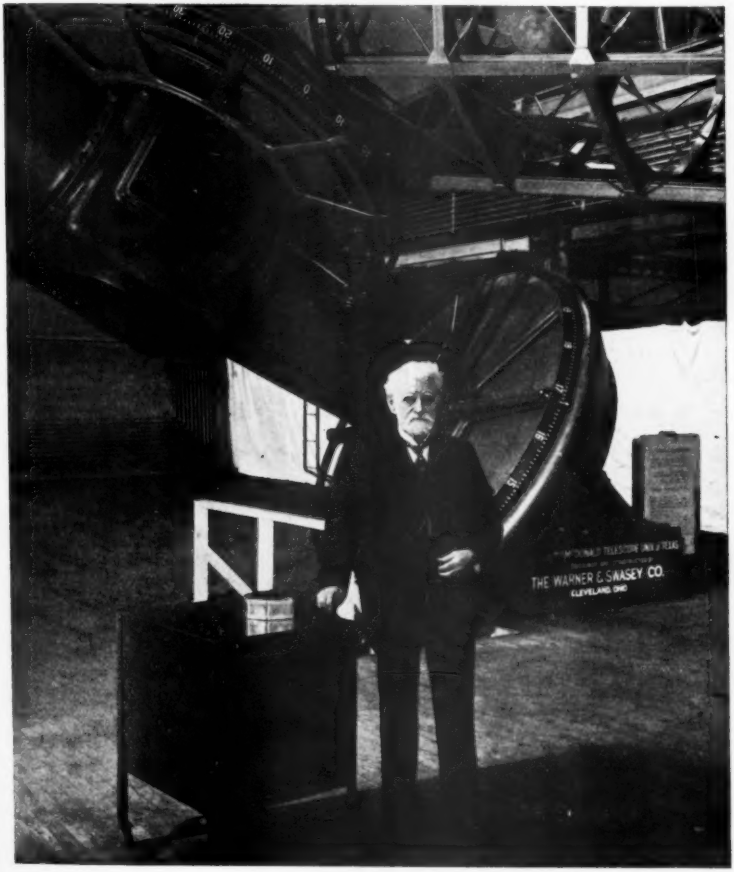


FIGURE 3

MR. SWASEY ON HIS EIGHTY-NINTH BIRTHDAY AND THE MACDONALD TELESCOPE MOUNTING IN THE SHOP AT CLEVELAND.

to furnish a 60-inch disc for the Perkins reflector. After a number of unsuccessful trials, the Bureau finally produced, in 1923, a 69-inch disc, the first large disc made in America.

Dividing Engine

Last May Mr. Swasey was asked, "What in your opinion is the greatest thing you have done?" All at once his eyes sparkled, his face brightened more than ever, and it seemed that a war veteran was getting ready to describe a famous battle. "The highest type of construction and piece of work I ever did," he said, "was the dividing engine. When you can take a spindle four inches in diameter and about twenty-five inches long with five-eighths inch taper to the foot and make that spindle fit into a bearing easily and when you drop it a thousandth of an inch it goes

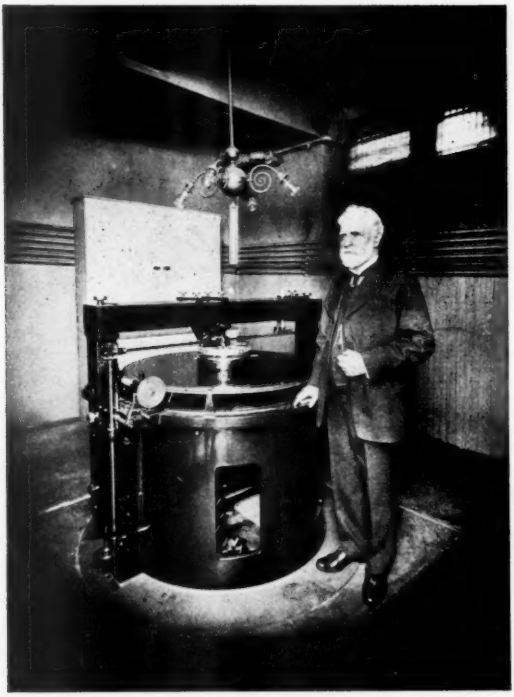


Figure 4
Mr. Swasey and the Dividing Engine which he considered his Greatest Achievement.

hard, you are getting down to a refinement about which we knew nothing in those times. Dividing engines had all failed in making the spindle —could not get a spindle in the bearing that would fit." The dividing engine was built primarily for graduating circles of astronomical instruments used for fundamental star work as well as for instruments in geodetic surveying. It has an error of closure of one second of arc and

required three years in building. It was fortunate that during this period Mr. Swasey had with him the most able assistance of Mr. G. Fecker the talented optical expert.

The joy of working for and attaining accuracy in machines was an inborn characteristic as it is in many of our greatest scientists. To construct a machine as accurately as is humanly possible to do and to make it durable, beautiful, and practical was the motive power of his great career. This aim is evident in all he has done, in planning a building for some college campus, in the establishment of a Foundation, or in building a telescope.

Engineering Foundation

Mr. Swasey took an active part in the foundation of the American Society of Mechanical Engineers and in 1904 served as its president. His interest, however, extended to other engineering and scientific societies.

His association with scientists and engineers strengthened his belief in the value of research to engineers and industry and, at the same time, he perceived that its importance was not sufficiently apprehended. Realizing the need, he conceived and, in 1914, established the Engineering Foundation for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind. This was the first known instance of a Foundation devoted primarily to engineering purposes. His gift amounting to three-quarters of a million dollars has contributed in many ways to the advancement of the profession which was so dear to him and made possible the initial organization of the National Research Council. The activities of the Foundation were wisely and broadly planned, to be readily adaptable to the varying needs of the profession. The Foundation well expresses the deep interest of Mr. Swasey in things which upbuild and endure.

The Builder of Men

We need but contemplate the fine machines and astronomical instruments which his firm built to realize that Mr. Swasey's inventive and mechanical genius as well as his love of precision and artistic design contributed greatly to his successful career. He was able to recognize greatness and nobility in men and to choose his friends wisely; they enriched his life as he enriched theirs. We find among his astronomical friends such men as John A. Brashear, Alvan Clark, Simon Newcomb, Asaph Hall, Edward C. Pickering, Charles A. Young, James E. Keeler, Sherburne W. Burnham, and Edward E. Barnard. "These men stand out as first magnitude stars in the realm of astronomical science, and to have had some part in their great work for science and humanity is indeed glory enough and compensation enough."

Another factor which contributed to his success was his ability to select capable young men and systematically to train them. He and his

partner were among the pioneers in establishing an apprentice school which goes as far back as 1880. "They call this the age of metals and machinery," Mr. Swasey used to say, "but the time will never come when the world will not need fine men more than it needs fine machinery." Toward this need he worked as assiduously as he did in building machines and telescopes.

Honors

It was but natural that he should be the recipient of many honors both at home and abroad. He held six honorary degrees, and membership in many engineering and scientific societies, including the National Academy of Sciences and the American Philosophical Society. He was a

Figure 5
Mr. Swasey observing the Eclipse of the Sun at Douglas Hill, Maine, on August 31, 1932.

Fellow of the Royal Astronomical Society and Officer of the Legion of Honor (France). He was awarded numerous medals. In 1924, in recognition of his many contributions to the development and progress of engineering, Mr. Swasey received the John Fritz Gold Medal, the highest honor bestowed by the engineering profession in this country. In 1932, he was awarded the Franklin Gold Medal by the Franklin Institute in recognition of his development of methods and his invention of appliances for making machines, instruments of precision, and mountings for large telescopes.

He deeply appreciated the honors he received and in a way enjoyed the ceremonies which were inevitable upon such occasions, although he accepted them with respect and modesty. He wished to say, "It is a great privilege to be counted among the distinguished men of science whom you have already honored. I thank you for the joy that you have so graciously given me."

The following short narrative illustrates his modesty. When once Mr. W. H. Crocker of San Francisco remarked, "Why, Mr. Swasey, you are an astronomer." He replied, "When I was a boy, my father kept a great number of sheep and, when working around the barn and with the sheep, some of the wool rubbed off on me, but that didn't make a sheep of me. In later years, I have been working with scientists and astronomers and rubbing up against them, but it takes more than that to make an astronomer."

It was a source of great pleasure to Mr. Swasey when on his eighty-eighth birthday, Dr. Otto Struve announced the naming of Asteroid 922, "Swaseya." Dr. Struve's discovery of the asteroid was made on November 14, 1922.

Private Life

Mr. Swasey was married in 1871 to Lavinia Marston who came from his own New England state of New Hampshire. She was reserved, gracious, and deeply religious, much like her husband. At their home in Cleveland, they lived quietly with but little entertaining which was mostly restricted to out of town guests. There were no children. Mrs. Swasey died in 1913.

He travelled extensively at home and abroad, went around the world twice, and in 1917 for the third time visited China where for many years he had been interested in the collection of old coins and in promoting higher education. As an expression of his deep interest in Chinese education he provided funds for the erection of the Canton Christian College Y.M.C.A. building and the Science Hall at Nanking University.

The Chinese Observatory on the Inner Wall of Peking was established during the thirteenth century. The instruments shown in Figure 6 were made in France during the latter part of the seventeenth century. After the Boxer uprising five of them were removed to Potsdam by the Germans. Mr. Swasey took an active interest in the return of them to their original foundations in accordance with the Treaty of Versailles.

His life-long interest in architecture and his love for the beautiful contributed materially to the architectural design of many college buildings for the erection of which he gave the funds.

His interest in engineering and research, in higher education, and in the Baptist church are well expressed by his generous contributions. "Whatever success I have had," he used to say, "which enabled me to make these gifts, I owe not to myself but to the fact that I have had a good mother, a good wife, and a good partner in business."

His unusually robust constitution kept him active until the end. Only last summer he paid a short visit to his friends in England. On the occasion of the presentation of the Hoover Medal in December last, he took his full share in the ceremony, including a short speech of acceptance. In April he attended the meeting of the National Academy of Sciences in Washington.

FIGURE 6
MR. SWASEY AND MR. BRASHEAR AND THE PEKING INSTRUMENTS.

On May 21, a cold confined him to his Cleveland home but his strength was now rapidly failing in spite of his great will to live. On June 9, upon his insistent request, he was taken to his native home in Exeter. The end came a week later.

His active life covered nearly three-quarters of a century. His achievements in his chosen field and his influence for good have made us all the richer. We may well rejoice that his noble life coincided with part of ours.

CASE SCHOOL OF APPLIED SCIENCE, JUNE 24, 1937.

Pilgrimage to a Tropical Observatory

By E. P. MARTZ, Jr.

A general discussion of a trip to the Private Observatory of Professor William H. Pickering, at "Woodlawn," Mandeville, Jamaica, British West Indies, in the spring and summer of 1936; and a brief, preliminary summary of observational programs and results undertaken there by the author; with a description of the Observatory, instruments, and Professor Pickering's work.

(Continued from page 374)

On my second day at "Woodlawn" I had the pleasure of meeting Professor and Mrs. Pickering's daughter-in-law, Mrs. William T. Pickering, and her daughter, Miss Anne Pickering. These very charming and cultured ladies, whom no one could possibly see without realizing that they are mother and daughter, were, like everyone else at "Woodlawn" and in Jamaica, very kind and helpful to me. I can never hope to express my appreciation and pleasure in the delightful times we had together. I can only hope that I may always consider them, and Professor and Mrs. Pickering, among my closest and dearest friends. Though the W. H. Pickerings' son and family live in Southern California, there can be no mistaking the charming and delightful quality of the East that imbues the entire family. (And I certainly do *not* wish that to be construed as meaing that I feel Californians to be the opposite!) Family facial and personality characteristics are strikingly similar and delightful in all the Pickerings that I have known; even, it seems, in those who are Pickerings by marriage! Of course, the most striking resemblance, was the well-known similarity between Professor William H. Pickering and his brother, Professor Edward C. Pickering. W. H. Pickering told me that he had once been recognized by a man who had never seen him, but who knew his brother Edward!

At "Woodlawn" the British custom of having tea at about 4:30 P.M. was followed every day; and the many long talks we five had through the fragrant Jamaican twilight are memories of the greatest delight to me. At about eleven each morning Professor Pickering and I would have lemonade and bread and butter sandwiches on the veranda overlooking the tropical gardens and the valley. Our discussions of astronomical problems, observations, and personalities in the world of astronomers, invigorated and stimulated me to more actual mental ambition than I had ever known before. These two "in between" tete-a-tetes and "lunches" were in addition to the regular heavy breakfast, dinner, and light supper of the tropics! Thus, almost five meals each day; and I am afraid I must admit that I made them practically just that! Though doing less actual physical work than ever before, I ate more than I ever have, during my months in Jamaica with the Pickerings. The recording

of the discussions, arguments, and friendly talks we had, would fill many more pages than are available here; and I am sure would possibly be more interesting than the discussion of my observations from "Woodlawn." They were not all on things astronomical. The Pickerings are lovers of music, as am I, and many happy hours were spent before their electric victrola in the high front room at "Woodlawn," listening raptly to the symphonies of Beethoven and Tschaikowsky, the operettas of Gilbert and Sullivan, and the incomparable melodies of Schubert and Anton Dvorak. Often, on a cloudy night, (and there *were* a few!) we would sit, clustered in the living room, listening to Mrs. William H. Pickering reading delightful poetry from Virgil in her exquisite Latin, or to her German renditions of Goethe; and her expressive interpretations of the English masters. I can only hope that those nights, when I sat, or huddled crosslegged, beneath the rows of cases filled with books, and listened to her cultured and charming voice as it rose and fell, may not vanish. I know that they shall not.

After I had been in Jamaica for a week or two, a regular routine settled itself upon me, and mercifully slowed down the tempo from the exciting pace that had been followed during the journey to Mandeville, and in seeing so many interesting new sights. In the morning I would go to "Woodlawn" and work with Professor Pickering on the map of Mars, or write letters for him and assemble tables, until our "lemonade" and morning talk at eleven o'clock. Usually I returned to "Delbrook" for lunch; but several enjoyable dinners and suppers were had at "Woodlawn," from the pewter tableware and exquisite china which Mrs. Pickering collects and prizes so highly. The early afternoon was spent in the same fashion as the morning; working in Professor Pickering's study, or at my own little desk in the secretary's ante-room. The experience of constant work in close contact with so great a man as Professor Pickering was a remarkable stimulation and delight. Following afternoon tea, at which were often charming British guests or visiting fellow Americans, we would talk on into the dusk; or listen to a symphony; or occasionally finish up the tag ends of the day's work, and then read the latest astronomical periodicals and letters which had come in the afternoon mail. Then, supper at "Woodlawn," or home to "Delbrook" for the evening. If the sky was clear and gave good promise, (as it usually did), I would leave "Delbrook" at nine or ten P.M. and return to "Woodlawn" and the observatory for a very full night of the fascinating work of observing the planets and the Moon, and making as complete record notes and drawings as possible in the pursuit of the several observational programs being followed. These were discussed with Professor Pickering the next day; and then checked in a preliminary manner with the previous work of other observers of the same objects. The majority of my observing in Jamaica was done between eleven P.M. and three or four A.M., as the seeing and visibility were by far the best between these hours. I find that four hours of steady work

at the telescopes and notebook, at a stretch, is just about my limit, even when reinforced by numerous cigarettes to keep one's errant eyes open and the mosquitos away; as well as by several bananas or mangos "stolen" furtively from the many bunches hanging day and night from the roof of the porch at "Woodlawn." And then, in the wee hours of the early morning, tramping home to "Delbrook," on the winding and unlit forest road, with the brilliant image of Jupiter riding high, or the waning last quarter Moon in the west, and the great bright wedge of the Zodiacal Light rising high in the east.

Of course, observations of the young crescent Moon had to be made in the early evening; and those of Mercury in the late afternoon. The planets Jupiter and Saturn though, on which much work was done, were usually near the meridian at one A.M. or so. The stars, which were used for the program on stellar definition and in comparing the telescopes, for different focal ratios and apertures, were always there. No observations were ever attempted on an object at an altitude of less than 35°, except in the case of Mercury and the crescent Moon. If clouds came up after midnight, as they occasionally did for a little while, I lay down to rest or sleep on the veranda swing, or in Professor Pickering's big morris chair in the house, until they passed away. The only trouble was that I, of course, often passed into a deep sleep, and would wake to find the planets and the Moon dimmed by the brilliant rays of the rising Sun. Professor Pickering observed before midnight with me on a number of nights; primarily when working on Jupiter's satellites and our own Moon. We would never compare our notes and drawings though, until the next morning; so that we would both avoid unconscious bias in our work that night.

Four main programs of observation were carried on last spring from Jamaica. One hundred fifty large-sized notebook pages of observations were recorded, and 105 complete drawings of delicate planetary and lunar detail were made. However, my work at the University of Chicago this past fall and winter has made it impossible to complete the analyses of much of this work, and to get it into published form. Therefore, the brief summary that follows is merely a preliminary and sketchy one, and should be interpreted as such.

Probably the work of primary interest to Professor Pickering and myself, was the program of observations of the changing disk forms, ellipticities, and surface markings on Jupiter's Third Satellite, Ganymede. Observations and analyses by the Rev. T. E. R. Phillips of the British Astronomical Association Jupiter Section, by A. E. Douglass, Guthnick, Stebbins, Antoniadi, and others indicate that the period of rotation of this largest satellite equals its period of revolution around Jupiter: 7 Earth days; and thus that it, like Mercury, always turns the same face toward its primary (due to the great tidal drag of that planet on the mass of the satellite). However, observations by W. H. Pickering, G. H. Hamilton, M. Jarry-Desloges, and my own work from Jamai-

ca indicate a rotation period for the satellite that is materially shorter than one earth day. The observations by Pickering, Hamilton, and myself showed remarkably swift changes in the actual *shape* and size of the satellite's disk, of such a nature that could not have been caused by poor seeing, and so large that they are certainly objective. These were often observable in as short a period as one hour! Pickering has proposed the hypothesis that the satellite has the shape of a prolate ellipsoid rotating awkwardly end-over-end in a period of the order of magnitude of several hours. This would explain the observed changing shapes and disk forms in a satisfactory manner (*Publications of the Astronomical Society of the Pacific,* August, 1925). Phillips also observed changes in the shape of the satellite, but found them to correspond to the revolution of the planet around Jupiter, in 7 days. My own Jamaica observations uphold the short period, primarily on the evidence of the very short period changes observed in the disk-form. On a number of nights I saw the disk shape change and measured, with a filar position micrometer, distinct changes in the position angle of the major axis of the disk, as many as five times in a period of four hours! Undoubted surface detail was present on twenty nights, and drawings were obtained, using magnifications of 320× to 790× on the 12.5-inch reflector, in periods of extraordinary good seeing. The appearance of the disk was often strikingly like that of Mars when the Syrtis Major is on the central meridian. This has also been observed by Jarry-Desloges, Antoniadi, Pickering, and many others. My own detection of the Syrtis Major-like marking on Ganymede was made when I was still in entire ignorance of the work of these other observers, and so was not due to any preconception. Its objectivity was striking during good seeing, as was its green color, and the yellow of the rest of the disk. Rapid changes in surface detail over a period of hours, on many nights, also corroborate the short revolution period (one Earth day or less), indicated by the disk-form observations. For further important references the following should be consulted: *Annals of Lowell Observatory,* Vol. II; *Observations des Surfaces Planetaires,* Jarry-Desloges, Fasc. III-VIII; *Harvard Observatory Annals,* Vol. 82, No. 4; *Monthly Notices of the Royal Astronomical Society,* Vol. 82, 1921, p. 97; *Lick Observatory Bulletin,* Vol. 13, 1927-8; *Astronomische Nachrichten,* 218-19, 5209-56, 1926. Amateur observers should recall that *very good seeing conditions* and a telescope of at least 5-inches aperture, with magnifications of higher than 300×, are required to view satisfactorily the phenomena recorded. Thorough analyses of my own observations and a comprehensive survey of all the literature on the subject are now being prepared.

A series of 35 drawings of the disk of Jupiter, and color observations with visual filters, of the changing nepholoidal markings, were made, and need not be discussed here further than to note that from the latitude of Mandeville, (18° North of the Equator), the planet was high in the sky at opposition and very favorably placed, revealing a wealth of fine

wisp and disturbance detail in the belts. The Northern Hemisphere was very active at this opposition; in particular, the North Equatorial Belt; and the Great Red Spot was quite prominent, as were wispy *white* areas seen "overlying" it, and also in the Equatorial Regions. These "clouds" were also seen by Mr. Latimer Wilson. To me, from Jamaica, the planet gave much the same general appearance as I find recorded in drawings and photographs of the apparition of 1927-28.

Observations were made of the changing dark markings on the floors and walls of the lunar craters: Eratosthenes, Plinius, Theophilus, Conon, and the twin craters Messier and W. H. Pickering. (The latter was previously known as "Messier A," but was renamed by the lunar Committee of the International Astronomical Union in 1935, in honor of Professor Pickering.) In particular, Eratosthenes on a number of nights near full Moon, with good seeing conditions, presented a most striking and very *peculiar* appearance that was not common at all to the surrounding craters and maria, an appearance *very* hard to reconcile with the usual conception of bare, lifeless, rock floors, and no moisture or atmosphere. Certainly, an appearance unexplainable by the hypothesis of ". . . changing angles of solar illumination," that is usually used as an argument in opposition to the ". . . fungus-like vegetation" hypothesis of Professor Pickering and others. The craters, Messier and Pickering, (which are on the west limb of the Moon, and have two white streaks like "comets' tails," radiating northward and eastward from them), also have peculiar changes during each lunation, which were recorded from Jamaica last spring. The changes in shape and form of the craters, and in the position angles of their major axes, are very large and conspicuous even in a 3-inch telescope; and occur without regard or likeness whatsoever to the normal "shadow changes" which are due to varying altitude of the Sun over the craters. However, I am not at this time prepared to present an interpretation of the significance of these changes; nor to do more than to corroborate the unusualness of them, and note that I firmly believe them to be *very significant,* and worthy of much careful and prolonged study by many coöperating observers.

A series of observations and drawings of the planet Mercury were made by myself from Jamaica, in coöperation with Mr. Walter H. Haas, who also observed the planet with the 10-inch refractor of Mount Union College Observatory, Alliance, Ohio, between April 22 and July 30, 1936. Our coördinated observations indicate the objectivity of the dark Mercurian markings and the whitish "polar cusp caps," visible in the crescentic phases. They appear to indicate a period of rotation for the planet equal to that of its revolution around the Sun: 88 Earth days. Both Mr. Haas and myself corroborate the statement of Jarry-Desloges, that the markings on Mercury are more distinct than those on Mars would be, if Mars were seen under the same poor conditions of low terrestrial altitude, poor seeing conditions, and proximity to the Sun as Mercury is observed in.

Possibly the most important observing program that I undertook while at "Woodlawn," and the one of which I have unfortunately done the least analysis of my observations, was the study of the effects of diaphragming the apertures of all three telescopes, in many different ways, on the character of the lunar, planetary, and star definition. Certain general statements can be made, however, from a preliminary inspection of the data obtained in these experiments. Primarily, there seems to be definite evidence that up to a certain limit all types of definition are bettered by diaphragming. This limit is reached when the diaphragm cuts out so much light as to seriously impair visual observations on account of the dimness of the image. I might emphasize that *down to apertures of 6-inches* I found very little difference in the actual *resolving power* on lunar and planetary detail, between small (6-inch) and large (up to 12.5-inch) apertures; even though I am, of course, fully aware of the familiar, basic formula of optics which indicates increased resolving power with increased aperture! It must be noted, however, that I was *not* working on double stars, where that formula undoubtedly holds true; and also, that I was observing in what are probably as close to *perfect* seeing conditions as we are likely to find on the surface of the Earth. So far as I could determine, the main advantage of large apertures, under the conditions I was working with, was primarily, (if not wholly), in giving increased *intensity* of the images, and hence, in most cases, making the delicate detail *easier* to see, although *not* showing any *more* than did the small apertures. That is to say that, with proper diaphragming, and tube ventilation, and constant good seeing, I could see the same amount and type of very fine planetary and lunar detail with a 6-inch aperture (and *long focal ratio*), as I could under the identical conditions, but with apertures up to 12.5 inches! (*But with decreasing focal ratio.*) I fully realize the rather radical tendency of these remarks, and would like to offer them merely as a *tentative* interpretation of my Jamaica experiments; though I am fully convinced of the soundness and objectivity of the experimental methods and the observations themselves. Further, there seems to be good evidence, from my experiments, that fine planetary detail, and even the size and character of the stellar disks and diffraction rings, are largely dependent upon *focal ratio* (aperture of the telescope divided by its focal length)—that is, relative focal length, rather than only on the aperture and figure or quality of the optical system. Jarry-Desloges and W. H. Pickering have also emphasized the importance of *focal ratio* rather than aperture, for good planetary definition. I am also of the firm opinion, derived from many direct comparisons, that a good parabolic mirror of at least F: 15 focal ratio will give *at least as good* planetary definition, as the usual achromatic refractor of the same aperture. (And, of course, with the increased advantage of no *chromatic* aberration, except from the eyepiece, if it is not an achromat or Tolles.)

Other experiments were carried on, suggested by early work of Pro-

fessor A. E. Douglass, with eccentric diaphragms, placed so as to avoid the flat and its support. These give good indication that a circular, eccentrically-placed diaphragm will give much better definition, than will a diaphragm of a good deal larger aperture but *centrally placed* which includes the flat and its support. This is undoubtedly due to the absence of the support and the flat obstructing the field of view, as these break up the diffraction pattern-image of an object, as explained by Pickering and others. Preliminary work with an electric fan set to ventilate the telescope tube (*without jarring it*) showed an increase in definition resulting from its use on certain nights; and indicated the need for further work, both theoretical and practical, on the convection currents in open and closed telescope tubes and their effects on the definition of the telescope. It might be well to note again that all these experiments were carried on with three different telescopes, and that the results were essentially the same; thus eliminating the possibility that the results were due to faulty figure of a single telescope. Professor Pickering describes at greater length certain similar work with tube ventilation, etc., in his two papers in POPULAR ASTRONOMY previously referred to in this article.

Careful record was kept several times each night, and for each drawing and observation, of the time, temperature, relative humidity, visibility, and seeing. Relative humidity was read from a hygrometer; temperature from two thermometers; visibility was estimated on a personal scale of four divisions, over the interval: "Heavy haze, but observations possible through it," to "Essentially perfect visibility." The seeing was judged on a personal planetary scale of seven divisions, based on the character of the limb of a planet or the Moon, over the interval between: "Limb vibrating badly, and giving double images," to "Limb perfectly sharp and still, and no haziness of detail." However, the readings on this scale have been reduced to universal readings on the "Standard Scale of Seeing," of ten divisions, based on the character of the star disk and diffraction rings, as it has been developed by Pickering, Douglass, and Lowell. Graphs of relative humidity versus seeing for Mandeville indicate that high relative humidity corresponded with better seeing conditions. Similar results are indicated for visibility versus seeing; except that, under certain conditions, better seeing and definition was obtained for the Moon, if a small amount of light haze was present, reducing visibility. This is in accordance with observations by many other observers. Lower temperature, in the interval observed at "Woodlawn," between 60° F and 70° F, showed a tendency to correspond with periods of good seeing. This is in full accord with the graph of temperature versus relative humidity, which showed a similar inverse proportionality; as would be expected on comparing these two graphs with the directly proportional graph given by seeing versus relative humidity. A summary of the graphs indicates that, in Jamaica, *good* seeing was associated with high relative humidity (80 to 85 on a scale of 100 indicating a saturated atmosphere), low temperature (for Mandeville), and

constancy of temperature (between 62° F and 65° F), and highest visibility (with the exception for the Moon noted above). As Professor Pickering has noted for many years, I also recorded the striking correlation between heavy dew-fall and extraordinarily good seeing. I think I may safely say that the very *worst* seeing I ever experienced from "Woodlawn," Jamaica, (when the sky was clear enough to make observing worthwhile at all), was markedly *superior* to the *very best* seeing that I have ever seen in seven years of observing in various parts of Illinois and Wisconsin, (including Lake Geneva!), and in the Eastern United States.

I must certainly not fail to mention the very enjoyable days I had with an amateur astronomer of Jamaica, Mr. Cyril N. King, who lives with his sister, at Newport, six miles from "Woodlawn." My meeting with this graduate of Harvard University was an almost comical, happy ending to a hot, tiring morning's labors at "Woodlawn." I was carrying the long white tube of my 6-inch, 90-inch focus telescope down the dusty road between "Delbrook" and "Woodlawn," strapped over my back and shoulders, and was panting and perspiring freely in the boiling heat of the tropic midday Sun. Suddenly, from a hundred yards behind me, a voice raised itself in the cloud of dust that my labors had made in the road, "Ahoy there! Ahoy! . . ." I was rather startled, needless to say, by the figure of the tall, middle-aged English gentleman in white linens, who came sprinting rapidly after me. "I say . . . *what* are you doing walking with an *Astronomical Telescope* down the King's Highway?" he queried excitedly of me. And thus began my friendship with Cyril King, whose joy at meeting another devotee of astronomy in the isolation of the Jamaican hills, was as unbounded as my own. At his pleasant little home, six miles away in the hills, I was to see four or five telescopes that he had constructed himself, including a 12.5-inch F:15 reflector (200-inch focus!). We spent happy hours talking over silvering difficulties, tropical observing, and the innumerable "gadgets," inseparable from the hands and minds of all telescope makers and observers. I only regret that the lack of transportation facilities to Newport from Mandeville prevented me from spending more time than I did with Mr. King and his charming sister. They had been close friends of the late Professor Hamilton and of Mrs. G. H. Hamilton at "Iona," Mandeville; and so they had many anecdotes and delightful stories of the characteristics and work of that extraordinary man, to recite to me. Tales of other amateur astronomers in Jamaica floated in to me from time to time, but I never had the pleasure of meeting these other gentlemen. There was the priest in Kingston, with a telescope, who was soon to leave for a holiday in England. There was the reputed "*four ton*" telescope of a Board of Education official, also in Kingston. I believe that this latter turned out eventually to be a *4-"inch"* telescope! A mechanician near Kingston was reported to have made a telescope, and there were several others, all of whom I hope to meet and talk with another

time in Jamaica. The late, well-known meteorologist, Maxwell Hall, a friend of Professor Pickering, for many years kept a well-equipped observatory with a 4-inch refractor at Montego Bay, Jamaica. The telescope is still somewhere on the island.

With the exception of the short daily showers on Jamaica, the weather was remarkably good until the last of May. Then the spring rainy season of the tropics set in, and turned out to be the worst that Jamaica has experienced since 1870, or thereabouts! However, most of the rains came during the daytime and early evening, so that many nights were clear in May and June, and I was able to observe with excellent visibility and seeing conditions on well over 50% of the nights I was on the island; and many nights when I did not observe were also clear and usable. Though the rain occurs mostly in the daytime, there is scarcely a day in the whole year on which the Sun does not shine some. It is certainly of striking interest to recall that, one time in May, in *24* hours over *fifteen inches* of rain fell, and was recorded at "Woodlawn"! Compare this with our middle-western "thunder storms" of a "stupendous" *half-an-inch* or so fall of water! For the month of May, using the rain gauges standard on the island, Professor Pickering recorded a total rainfall of about *40 inches!* This, as well as the above-mentioned fifteen inches in 24 hours, was corroborated by the official weather bureaus. However, though the lowlands and Kingston were often badly flooded, the surface rock in the mountains is a very porous layer of limestone, several hundreds of feet thick, which rapidly absorbs and drains off the excess flood waters. In early July the rainy season abated, and the unusually fine skies of the tropics were again constantly present.

Large, swift-moving cumulus clouds are usually prevalent over Mandeville and "Woodlawn" during much of the daytime, making conditions unsuited for Venus or Mercury observations; though after ten o'clock at night it is very rarely cloudy until dawn. The climate and temperature are very nearly constant; the latter very rarely varying, in the spring of 1936, from about 60° F at night and 80° F during the day, at "Woodlawn." The crystal clear transparency of the night sky is remarkable; and meteor frequency counts by several different methods gave me an average rate of 16 meteors per hour (naked-eye estimates for *one observer, over a field 60° square, on non-shower nights*). These included, as well as many very faint meteors, quite a remarkable number of very brilliant fireballs and bolides. The brilliant wedge of the Zodiacal Light was clearly visible in the east at about 3:30 A.M. (Eastern Standard Time), each morning, looking quite like a "false-dawn." For weeks before and after opposition, Jupiter, when near the meridian, was observed to cause a definite and quite dark *shadow* by any object obstructing its light! Its great brilliancy was due, (as well as to its nearness to the Earth, and to the great sky transparency), to its altitude, which, from Mandeville, at latitude 18° North, was much higher than we see it in the United States.

Looking back on those wonderful days and beautiful nights, they seem to me almost as a glorious dream at times. But tropical Jamaica, "Woodlawn," and the Pickerings are very real, and very close; and it almost seems as if I could get up from my typewriter, walk into the next room, and talk with Professor Pickering, as we sip our tea and look out on the beauty of the tropical hills and valleys beyond. Recently, Professor Pickering wrote me that the spring of 1936 was one of the most enjoyable he has had in some years. Certainly, it was the happiest the most profitable, and the most wonderful one that *I* have *ever* had in my young life. Lack of space has necessitated leaving out much of interest and significance in the record of those months with Professor Pickering; but I hope that a small measure of what I gained that spring may have been transmitted to the reader through these pages.

Of the return voyage to New Orleans from Kingston in mid-July, there is not much to tell, save that it was as enjoyable as the first one, but more peaceful and restful now that my first thirst for the tropics had been temporarily satiated. Many kind and good friends were made on these two trips, as well as during my stay in Jamaica, and though I cannot attempt to enumerate them or our experiences here, the remembrance of their faces, personalities, and those experiences, will be with me in memory until we meet once more, and longer. In delightful New Orleans, after the return voyage, I stayed for a week, during which time I visited Tulane University of Louisiana, became acquainted with the members of the Department of Middle American Research, and was treated to several very enjoyable evenings and days of true Southern hospitality by Mr. and Mrs. Maurice Ries, and Mr. Ernest Noyes, of the Department. My interest in the ancient civilization of the Mayas of the Yucatan, Mexico, and in the astronomical observation records in their codices (books), and on their carven stone stelae, or monuments, was an "open-sesame" to their hospitality. I had the pleasure of talking for some time one morning with Dr. Hermann Beyer in New Orleans, who is one of the outstanding authorities on the Maya "Lunar Calendar," and the correlation of their chronological systems with the Christian systems of dates. During this talk, my interest in the subject was stimulated even more, by finding out how little I really knew and understood of the problems and interrelations involved, and how much more there is to work on. I did find out, much to my surprise, that the so-called Maya "Venus Calendar," (an ephemeris apparently of observations of heliacal risings and settings of the planet, as morning and evening star), is now coming, in some quarters, to be considered, *not* a record of visual observations of Venus by the Mayas, but as something entirely different! My concern at this will be perhaps better appreciated when I note that I had previously written two short papers based entirely on the observations and findings of the supposed Mayan "Venus Calendar"! However, this merely indicates another field of endeavor for fertile minds, to straighten out this apparently complex tangle of dates,

astronomical symbols, and dieties.

However, all this time, and for many weeks after my return to my home near Chicago, my mind and spirit were still in the tropics. I was still surrounded by the intensity, the beauty, and the happy times of the previous spring in Jamaica. And the memory of those months will not soon fade away . . . I can do little more now than to express again my very deep appreciation for the aid of all those who were instrumental in making my little expedition possible. In particular, to Professor and Mrs. Pickering, and my other friends on the beautiful island of Jamaica. The contacts and stimulation of the past year, and the kindness and encouragement of many friends in the "Astronomical Fraternity of the World," have been a very great factor in my decision to take up astronomy as my life's work. I can only hope and trust that the thought-provoking observations and experiments, which were made while in the West Indies, may in some measure justify, and compensate for, the help which I have received from so many others. . . .

It is impossible, though, to leave without one final recollection, viz., that of the island of Jamaica disappearing into the far distance of a late afternoon haze, as I lean alone on the rail of a trim Caribbean steamship, and watch, with misty eyes, the gradual vanishing of my home for four months past . . . I hummed to myself, that twilight evening, the tune of Queen Liliuokalani's "Farewell To Thee"; written for farewell to another island, Hawaii; but just as applicable to this "island home." The words of the song ran through my brain; filling it sadly and sweetly, with visions of the beautiful land I was leaving, and with the splendour of the tropics. I saw the telescopes still pointing skyward at "Woodlawn"; Professor Pickering's kindly, smiling face; the glory of the star-filled heavens . . . And then, again, the disappearing island, low on the horizon; the majesty and beauty of the towering background of mountains; and once more,—blue waves, breaking white, on sandy, palm-fringed shores . . .

FEBRUARY 27, 1937.

Alaskan Earthquake Observed at Washington*

By F. P. SCOTT and LLOYD R. WYLIE

The earthquake of July 22, 1937, with center of disturbance near Fairbanks, Alaska, was noted by the writers, two observers of the U. S. Naval Observatory, as they were taking an observation with the 9-inch transit circle. For this observation the telescope was pointed vertically downward toward a basin of free mercury and coincidence of the threads in the eyepiece with their images reflected from the basin

*Communicated by Captain J. F. Hellweg, U.S.N. (Ret.), Superintendent U. S. Naval Observatory.

was noted. On this date the images were seen to be wandering around in a strange and erratic manner.

The disturbance was first noticed at 12:30 P.M., Eastern Standard Time. It was on in full force at that time, approximately 20 minutes after the time as given for it at Fairbanks, about 3500 miles away. Disturbances continued rather violently for 15 minutes, diminished about 12:50, and by 1:00 o'clock they could no longer be detected.

It was not possible to measure the magnitude of the maximum oscillation but the observers estimated it to be from 30″ to 40″ from one extreme point to the other. Period of oscillation was about three seconds. Superimposed on this oscillation was a smaller one with a period of only a fraction of a second.

The mercury basin used is a 10-inch pan which is floating in a second pan that is about 14 inches in diameter.

It might be added that observers on the 6-inch transit circle here noted no disturbances when they took an observation at 12:20, just ten minutes before.

Apparent Flashes Seen on Mars

By LATIMER J. WILSON

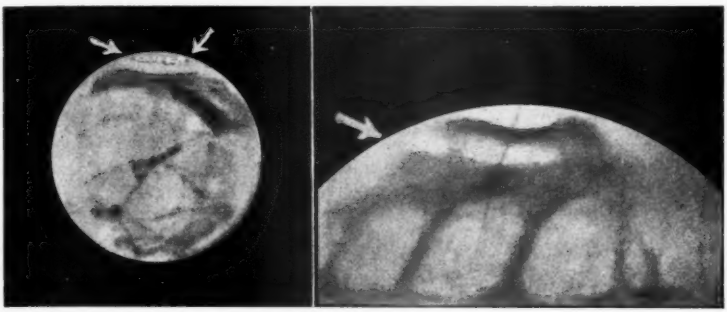
On May 30, 1937, during a part of the interval between $4^h\ 35^m$ and $6^h\ 0^m$ G.C.T., while Mars was being observed through a 12-inch aluminized reflector, 250 magnification, with unusually good seeing, what appeared to be a series of bright flashes was seen extending across the south polar cap about 1″ north of the southern rim of the disk. They were irregularly intermittent and were estimated to be about one magnitude brighter than the rest of the cap. They were entirely unexpected, but when once seen they became the chief concern of the observation period.

Measured from the drawings and photographs the thickness of the south polar cap on the central meridian was about 1″.87. The flashes extended almost midway between the northern edge of the cap and the southern rim of the disk. A line of tiny white spots seemed to extend across the cap, some of the spots coalescing to swell into a brilliant white spot which quickly became yellow, then red-yellow, the phenomenon passing from left to right across the polar cap. Because of the tranquil state of the atmosphere and the general steadiness of the well-defined disk of the planet, the phenomenon was interpreted as genuine. A Barlow eyepiece was used in which there is considerable chromatic aberration when the image is not in the center of the field and this, of course, should be considered, but, after watching a number of the flashes, I decided that the color changes were real.

There were two centers, or sources from which the flashes came, one in about longitude 190 degrees, and the other in 212 degrees. Plotting

the positions and allowing for the northern planetocentric position of the earth, it appears that the string of white spots and the flashes were along south latitude 55-65 degrees.

Drawings were made at $4^h\,35^m$, $4^h\,55^m$, $5^h\,30^m$ (when flashes occurred) and at $6^h\,0^m$ G.C.T. No flashes were seen after $5^h\,40^m$. Observations secured under good conditious when this region was presented favorably on the dates preceding and following May 30, although indicating unusual brightness in this area of the south polar region, disclosed no similar phenomena. Unfortunately, the photographs secured through the writer's telescope are hardly adequate to settle the question as to the precise nature of the phenomena.



DRAWINGS OF MARS

1937 May 30, $6^h\,0^m$ G.C.T. λ 210°.6 1924 Sept. 15, $14^h\,30^m$ G.M.T. λ 205°.2

(On drawing at left the arrows indicate the location of the line of flashes, though none were seen after $5^h\,40^m$, G.C.T.)

Observation of the planet since 1909 has not disclosed to the writer a similar polar aspect, though at other tlmes small, twinkling white spots have been seen in or at the edge of both caps. Professor William H. Pickering writes that many years ago he saw effects similar to those which occurred on May 30, and therefore confirms them as having occurred in the past.

Reference to Flammarion's map of Mars (POPULAR ASTRONOMY, April, 1916) indicates that the apparent flashes in south latitude 55-65 degrees were in the vicinity of Thyle I and Thyle II. As a tentative explanation it is suggested that possibly this region is the northern escarpment of a plateau, Mare Chronium being a deep depression. Slopes facing the sun and earth covered with ice might reflect sunlight in a series of flashes, the rotation of Mars bringing new reflecting surfaces into view, under a cloudless sky.

It would be very interesting to know if any other observers employing comparable magnification and aperture witnessed the phenomena described here. The white spots and the effect of flashing brightness were not seen in June, July, or August, though carefully looked for but

under less favorable conditions. The angle between earth, sun, and Mars was different at the later dates, and a repetition would hardly be expected.

Mr. Walter H. Haas, Alliance, Ohio, employing a 6-inch aperture under conditions of hazy atmosphere, did not see the polar phenomena of May 30, though his description of Mare Cimmerion is confirmed by the writer. Mr. John H. DeWitt, Jr., and his brother, Mr. Ward DeWitt, some distance from the writer's location here in Nashville, noticed unusual whiteness of the southern cap, but report that they did not notice any flashes.

1606 Woodland Street, Nashville, Tennessee.

The Fifty-Eighth Meeting of the American Astronomical Society

By CURVIN H. GINGRICH

This year as the time for the annual summer meeting drew near the thoughts of the members of the American Astronomical Society were centered on Williams College, Williamstown, Massachusetts. In the case of one hundred or more members and friends of the Society not only their thoughts but also their vacation journeys were directed toward Williamstown. Consequently on Wednesday evening and Thursday morning, September 8 and 9, on the campus surrounding Goodrich Hall and in the refectories on near-by Spring street numerous small groups exchanging greetings and obviously having common interests were in evidence. For some these astronomical reunions are semi-annual, for others annual, or biennial, or even at longer intervals, but in all cases they are most enjoyable and produce a rejuvenating effect. An invisible bond unites the directors of the large observatories, the research investigators, the teachers, and the independent workers, for whom in many cases astronomy is an avocation, into a homogeneous and mutually helpful organization.

Williamstown, located near the western terminal of the Mohawk Trail and surrounded by the famed and picturesque Berkshire Hills of Massachusetts, afforded a most alluring setting for the meeting. Those whose approach to Williamstown was from the west and who are accustomed to the more or less level stretches of the prairie of the Middle West, who were so fortunate as to arrive at the summit of Taconic Trail just at sunset, as was true in the case of the writer and those with him, immediately felt the beauty and grandeur of the panorama presented. The sun on the western horizon, the crescent moon following closely, the purple dusk rising above the hills which lay toward the east, the hills bounding one's vision at all points of the compass, with Greylock towering above them all, the evening chill, all combined to leave an impression long to be remembered. Doubtless the other approaches to

Williamstown furnished similar points of vantage.

Having arrived in Williamstown the visitors found ready and convenient living quarters in the dormitories of Williams College. After becoming settled for the three days' stay many congregated in the social rooms of the Faculty Club for conversation and fellowship on Wednesday evening, before the real sessions were begun. As scheduled the Council of the Society met for its opening session during the evening.

Promptly at nine-thirty on Thursday the president of the Society, Professor Henry Norris Russell, called the first general session to order. Dr. James P. Baxter III, who had assumed the duties as president of Williams College on September 1, welcomed the Society to Williams especially warmly since, as he said, it was the first of the learned societies to hold its sessions at Williams since he had become president. He spoke of the early days in the development of astronomy in America, having in mind the part contributed by Williams College, which was to be brought out more definitely later in the day. An appropriate response to the address of welcome was made by Professor Russell. Professor Willis I. Milham then made several announcements relating to the details of the events of the program for the next few days. The remainder of the morning session was devoted to the reading of papers.

At this session and two similar ones on Friday and one on Saturday, forty-nine papers were presented in full or by title. The schedule, which allotted not more than ten minutes to any paper and a shorter time to some, was closely adhered to. As these papers will be available in abstract form in the *Publications of the American Astronomical Society* and, in some cases, in other places, no attempt will be made to summarize them here.

Thursday afternoon was set aside for special recognition of the fact that the Hopkins Observatory of Williams College had this year reached its centenary. Two enjoyable and significant events constituted the principal features of this commemoration: First, a paper, by Professor Willis I. Milham, entitled "Early American Observatories" which revealed extensive and painstaking research in the archives of many institutions. The complete text of this paper will be published in the near future in POPULAR ASTRONOMY. Second, a reception tendered by Williams College to the company of visitors, attended by President and Mrs. Baxter, held on the campus near the Hopkins Observatory. During the reception and later an opportunity was given those who wished to do so to visit the Observatory and the astronomical museum in it. Also an astronomy exhibit was available in the college library, a part of the Chapin Collection. Here were found first or early editions of thirty-four distinct works on astronomy beginning with "Astronomica" by Marcus Manilius, issued in Nuremburg about 1472.

Thursday evening was devoted to the showing of moving pictures, many of them in color, made by the several parties who traveled to points on the path of the eclipse of June 8. Pictures were shown by

Mrs. Isabel M. Lewis, Dr. Menzel, Mr. Charles G. Thompson, and others. They included incidents on the journey, views of eclipse camps, and the phenomena of the eclipse itself. So vividly were the experiences of living on the uninhabited island of Canton and in the high altitudes of the Andes in Peru portrayed by the pictures that the audience felt the thrill of an eclipse expedition without undergoing its hardships.

At the conclusion of the morning session for papers on Friday morning the photograph of the group of members and guests was made. As the photograph was not available in time for this issue, it has been decided to use it as the frontispiece in the November issue of this periodical.

The society banquet was held at the Williams Inn on Friday evening. A bountiful dinner was served, after which Mr. William B. Stearns, who had represented the American Astronomical Society and the American Association of Variable Star Observers at the fiftieth anniversary of the Société Astronomique de France, gave a brief and entertaining account of that event. The remainder of the evening was spent in conversation in the spacious rooms of the Inn. An impromptu piano recital by Dr. P. van de Kamp, recently appointed director of the Sproul Observatory, added greatly to the pleasure of the occasion.

The business session was held on Saturday morning. The secretary reported that new members had been elected by the Council as follows:

Dr. Walter F. Baade, Mt. Wilson Observatory, Pasadena, California.

Dana Kavanagle Bailey, Student, Steward Observatory, University of Arizona.

Leonard Franklin Barcus, Vanderbilt Fellow in astronomy, Leander McCormick Observatory, University, Virginia.

Miss Elizabeth Roberts Cornwall, Assistant in Astronomy, Wellesley College.

Mrs. Bertha Grier Crissman, Computer, Allegheny Observatory.

Irvine C. Gardner, Physicist and Chief of the Optical Instruments Section, Bureau of Standards, Washington, D. C.

George R. Harrison, Professor of Applied Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Frederick Hollander, Assistant, Yale University Observatory, New Haven, Connecticut.

Harold Hooker Lane, Instructor in Astronomy, Shattuck Observatory, Dartmouth College, Hanover, New Hampshire.

Alvin Hughlett Mason, Astrophysical Computer, Smithsonian Institution, Washington, D. C.

Rudolph Minkowski, 813 Santa Barbara Street, Pasadena, California.

Thornton Leigh Page, Chief Assistant, University Observatory, Oxford, England.

George Wesley Palmer, Graduate Student, University of California Observatory, Berkeley, California.

Waldo Story Reed, 45 Park Avenue, New York City.

William Alfonzo Rense, Emerson McMillin Observatory, Ohio State University, Columbus, Ohio.

Edmund Schulman, Assistant in Cycle Work in Climatological Researches, Steward Observatory, University of Arizona, Tucson, Arizona.

Nathaniel Shear, Scientific Aide, U. S. Naval Observatory, Washington, D. C.

Albert W. Stevens, Major, U.S.A., Wright Field, Dayton, Ohio.

Philip H. Taylor, Teaching Fellow, Flower Observatory, University of Pennsylvania.

Charles Goodrich Thompson, Lawyer (President, Foundation for Astrophysical Research, Inc.), 15 Broad Street, New York City.

Rupert Wildt, Research Assistant in Astronomy, Princeton Observatory, Princeton, New Jersey.

The secretary announced further that

(1) Miss Anne S. Young represented the Society at the Centenary Celebration of Mt. Holyoke College.

(2) Mr. William B. Stearns represented the Society at the fiftieth anniversary of the founding of the Société Astronomique de France.

(3) the second award of the Annie J. Cannon Prize had been made by the Council to Mrs. Charlotte Moore Sitterly of Princeton University.

(4) the December (1937) meeting will be held at the University of Indiana, Bloomington.

The report of the tellers showed that officers had been elected as follows:

President .....Robert G. Aitken
Vice-President .....Frank E. Ross
Secretary .....John C. Duncan
Treasurer .....Frank C. Jordan
Councilors.....Leon Campbell, E. F. Carpenter, A. H. Joy
Division of Physical Sciences.....Wm. D. Macmillan
Nominating Committee—
H. R. Morgan, *Chairman*, C. H. Gingrich, J. Q. Stewart

The following resolution was then presented by Dr. John A. Miller and enthusiastically and unanimously adopted:

The members of the American Astronomical Society desire to express and hereby do express to President and Mrs. Baxter, to Professor and Mrs. Milham, and to the Board of Trustees of Williams College the hearty appreciation of the kind hospitality they have shown the members and our guests during the fifty-eighth meeting of this Society. The assignment to comfortable dormitories within a minute's walk to a well-equipped auditorium, also at our disposal, has facilitated materially our proceedings and every arrangement has been made for our comfort and pleasure.

The president then declared the fifty-eighth meeting of the American Astronomical Society closed.

However, Professor Milham had planned another event for those who wished to remain a few hours longer. Accordingly some fifteen automobiles under the leadership of Mrs. Milham made a trip to the Bennington Battle Field some twenty miles distant. Here the strategy and significance of this battle were described by Mr. Hart who was well qualified through long study and frequent visits to do so.

Returning the party made a brief stop on the unique and interesting campus of Bennington College, then another stop for lunch, and then finally separated, leaving behind gratitude and appreciation for kindnesses shown and carrying away most favorable impressions and happy memories.

SEPTEMBER 20, 1937.

Planet Notes for November, 1937

Note: All times, unless otherwise stated, are Central Standard Time.

The *Sun* will move from Libra into Scorpius during this month and be about five degrees north of Antares at the close.

The phenomena of the *Moon* will occur as follows:

New Moon	Nov. 2 at 10	P.M.
First Quarter	11 " 4	A.M.
Full Moon	18 " 2	A.M.
Last Quarter	24 " 6	P.M.

The moon will be at perigee on November 19 and at apogee on November 6.

Mercury at the beginning of the month will be only a short distance east of the sun and moving eastward more rapidly than the sun. By the end of the month it will be more than an hour east of the sun, but, as it will be slightly farther south than the sun, it will not be easily visible.

Venus will be following the sun eastward moving slightly more rapidly than the sun. As it will be somewhat north of the sun it will continue to rise before the sun throughout the month. It will be the morning star though near the horizon.

Mars will remain about five hours east of the sun and in nearly the same declination, and will therefore be observable in the early evening throughout the month. It will be moving eastward in the constellation Capricornus.

Jupiter will be near the planet Mars at the beginning of the month. It will be moving eastward more slowly than Mars and the sun. At the close of the month Jupiter will be low in the west at sunset.

Saturn will be most favorably situated for observation in the evening throughout this month. At the middle of the month it will be near the vernal equinox, that is, near the point at which the path of the sun intersects the equator when the sun is moving northward. It will be the most interesting of the planets for this period.

Uranus will be opposite to the sun on November 4. It will, therefore, rise about sunset, reach the meridian about midnight, and set about sunrise in the early part of the month. On November 15 its position will be R.A. $2^h\,36^m$ and Decl. $+14°\,47'$.

Neptune will be observable only in the early morning, and consequently will probably not entice many amateurs during this month. On November 15 it will be in R.A. $11^h\,28^m$, Decl. $+4°\,39'$.

OCCULTATION PREDICTIONS

(Taken from the *American Ephemeris*)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phe-

nomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.

Date 1937	Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION a	IMMERSION b	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION a	EMERSION b	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Nov. 8	226 B.Sgr	6.4	22 15.4	−1.7	−0.1	71	23 38.1	−1.2	−0.5	247
11	c^1 Cap	5.3	19 59.8	−1.5	+1.2	100	21 3.5	−1.1	+2.2	210
13	κ Psc	4.9	22 27.1	−1.1	+2.0	46	23 42.0	−1.7	+1.0	252
13	9 Psc	6.4	22 28.8	−1.6	+1.3	80	23 40.0	−1.2	+1.8	218
16	19 Ari	6.0	22 46.8	−0.9	+0.7	113	23 28.7	0.0	+2.7	202
20	ζ Tau	3.0	4 4.7	−1.7	−0.9	131	4 59.0	−1.4	+2.6	227
20	BD+20°1105	5.9	9 41.5	−0.4	−2.8	145	10 27.9	−1.3	0.0	236
22	1 Cnc	6.0	11 39.2	−0.8	−1.8	124	12 42.8	−0.7	−1.5	281
23	A^1 Cnc	5.7	5 37.9	−1.0	−3.0	168	6 12.0	−1.2	+4.2	226

OCCULTATIONS VISIBLE IN LONGITUDE +91° 0′, LATITUDE +40° 0′.

Nov. 8	108 B.Sgr	6.5	0 53.9	+0.4	+1.9	15	1 32.3	−2.0	−3.7	311
8	226 B.Sgr	6.4	21 38.6	−2.0	+1.1	57	23 8.1	−2.3	−0.4	266
13	207 B.Aqr	6.4	0 27.5	−2.8	−0.2	104	1 24.0	−0.5	+2.7	191
13	9 Psc	6.4	22 3.8	−0.8	+1.8	67	23 13.4	−1.1	+1.7	237
13	κ Psc	4.9	22 7.0	−0.5	+2.4	32	23 7.8	−1.4	+1.0	273
16	19 Ari	6.0	22 36.4	−0.1	+1.0	99	23 23.1	+0.1	+2.0	220
20	ζ Tau	3.0	3 39.0	−1.1	+0.2	121	4 32.8	−0.7	+2.3	232
22	1 Cnc	6.0	11 31.0	−0.6	−3.1	158	12 22.8	−2.1	−0.1	248
23	A^1 Cnc	5.7	5 28.6	..	..	178	5 45.8	..	..	210
23	60 Cnc	5.7	12 38.8	−1.2	−1.7	123	13 50.8	−1.1	−1.7	292

OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′.

Nov. 8	121 B.Sgr	5.9	2 4.1	−1.9	−1.4	102	3 11.1	−0.3	+0.5	221
11	ν Aqr	4.5	4 58.8	..	..	354	5 26.5	..	..	308
12	207 B.Aqr	6.4	23 30.3	−1.1	+1.6	76	0 42.6	−1.2	+1.9	228
14	16 Psc	5.6	3 20.1	−3.4	−1.0	112	4 7.2	−0.1	+3.8	182
20	ζ Tau	3.0	3 22.4	0.0	+0.8	99	4 14.4	0.0	+1.4	252
23	α Cnc	4.3	13 20.6	..	..	60	14 2.8	..	..	357
26	e Leo	5.1	13 55.0	−0.9	−2.3	160	15 4.9	−2.7	+0.1	268

Comet Notes

By G. VAN BIESBROECK

Two more comets have been discovered since the previous issue, making already a total of eight comets for this year.

COMET 1937 *g* (HUBBLE) was discovered on August 4 at Mount Wilson, California. The first notice sent out by director W. S. Adams gave the following information about this faint object found by Dr. E. P. Hubble.

1937 Aug. 4.4856 U.T. R.A. $22^h\ 49^m\ 19^s$ Decl. −21° 0′
Magn. 13.5 Daily motion 30ˢ west, 5′.5 south
Diffuse disk 30″ in diameter.

This was confirmed by numerous measures at various observatories. The motion being slow, the first determinations of the orbit were quite uncertain but after a few days the nature of the orbit was well established. The best orbit available at present is by A. D. Maxwell who used observations over an interval of two

weeks up to August 18. The elements are:

Perihelion passage	1936 Nov. 22.46593 U.T.
Node to perihelion	148° 36′ 36″.9
Longitude of node	96 37 36.7
Inclination	11 29 54.4
Perihelion distance	1.939539 astronomical units

This inconspicuous object was therefore found nine months after it passed nearest to the sun. It will still further decrease in brightness as shown by this short ephemeris:

1937	α h m	δ ° ′	Mag.
Aug. 23	22 37.9	−22 41	13.8
Sept. 8	27.8	23 41	14.2
Sept. 24	19.7	24 8	14.6
Oct. 10	22 15.2	−24 3	15.0

Periodic Comet 1937 *h* (Encke). This well-known comet was first recorded by H. M. Jeffers at the Lick Observatory:

1937 Sept. 3.3857 R.A. $2^h\,19^m\,4^s.9$ Decl. +27° 10′ 20″.

The comet is described as diffuse and the magnitude is as faint as 18. It required the combination of the California sky, the Crossley reflector, and a capable observer to record the expected comet when it was so faint, nearly four months before perihelion. A good deal of the credit, however, goes to the careful computer whose predicion (p. 382) came within 16′ of the observation. It appears that the comet will reach perihelion 1937 Dec. 27.76, only 0.51 day later than was predicted by A. C. D. Crommelin. L. E. Cunningham has corrected the ephemeris by allowing for the change of perihelion date:

1937	α h m	δ ° ′	Distance from earth	Distance from sun	Mag.
Oct. 2	2 2.3	+34 51	0.74	1.64	15.6
6	1 53.9	36 15	.67	1.59	15.2
10	41.9	37 44	.61	1.54	14.8
14	28.3	39 15	.55	1.49	14.3
18	1 9.3	40 47	.49	1.43	13.8
22	0 44.7	42 13	.43	1.38	13.3
26	0 13.2	43 18	.39	1.32	12.8
30	23 34.0	43 42	.35	1.26	12.3
Nov. 3	22 47.6	42 55	.31	1.20	11.7
7	21 56.4	40 29	.29	1.14	11.2
11	21 5.0	36 11	.27	1.07	10.6
15	20 17.3	30 20	.27	1.01	10.2
19	19 35.7	23 32	.27	0.94	9.8
23	19 0.2	16 32	.29	.87	9.4
27	18 30.0	9 52	.31	.80	9.0
Dec. 1	18 4.3	+ 3 46	0.34	0.73	8.6

The comet is very well placed for northern observers; during October it moves from the constellation of the Triangle to that of Andromeda; it will pass close to the Andromeda nebula on October 22 at which time it will begin to be visible in moderately sized instruments. In November it will move rapidly westward through Cygnus and Ophiuchus. In December the comet may reach naked-eye visibility but it will then be so close to the sun that observations will be difficult.

This is the 39th reapparition of Encke's periodic comet since its first discovery by Mechain in 1786. A great amount of work has been done on the orbit of this comet and the irregularities in its motion which cannot be explained entirely on the basis of Newton's law of gravitation. The comet will therefore be studied assiduously. Estimations of its brightness are of special interest in connection

with the probable slow disintegration of this type of body.

This summer, COMET 1937 *f* (FINSLER) has been watched with interest by a great many observers. In the beginning of August it reached 4th magnitude and was therefore easily seen with the naked eye. But what attracted most attention was the development of the tail which reached over 20° in length, and the rapid changes in its structure. Figure 1 combines two exposures taken with the 24-inch reflector of the Yerkes Observatory on two successive days, August 5 and 6. The

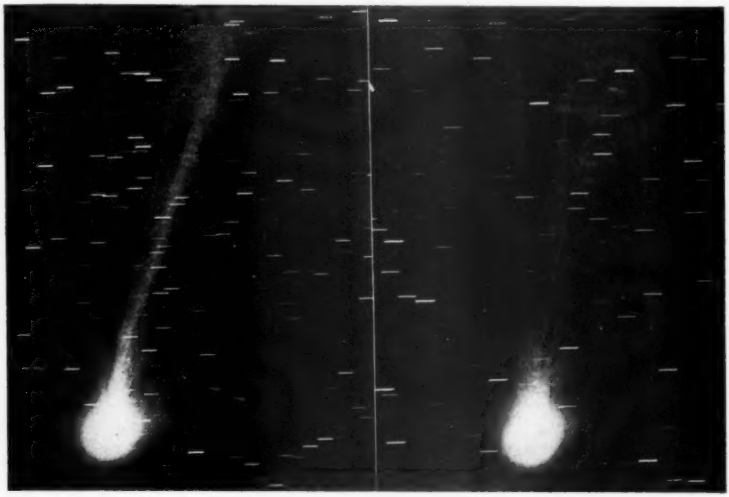


FIGURE 1

PHOTOGRAPHS OF COMET FINSLER MADE ON AUGUST 5 AND AUGUST 6, 1937, WITH THE 24-INCH REFLECTOR OF THE YERKES OBSERVATORY.

nucleus appeared stellar even under high powers. The coma was very bright so that on both exposures the brilliant head is very prominent. Besides there is a long tail, made up of a complex of small filaments; but on the first day there appears a lateral bend at half a degree from the nucleus while on the next day the stream of material seems much more evenly distributed. Aside from the main long tail there is a coarse and shorter one making an angle of some 50 degrees with the first; this gives an unsymmetrical appearance to the head and gives the impression that the main tail is not centered on the coma. All through August the changes in the tail have continued. A large number of photographic records have been secured at various observatories so that there is a fairly complete history of the fluctuations. The comet now passes out of reach on account of its close approach to the sun but southern observers will be able to follow it farther in the evening sky.

COMET 1937 *b* (WHIPPLE), although becoming fainter, is still well under observation. I estimated the magnitude as 11 in the beginning of September. It appeared then as a diffuse coma with a bright central nucleus. It moves gradually southward but will be visible for some time as is shown by the following

ephemeris:

1937	α h m	δ ° ′
Oct. 2	17 46.4	−11 15
6	17 54.1	12 30
10	18 1.8	13 39
14	18 9.5	−14 42

The decrease in brightness is slow.

In regard to COMET 1937 *d* (GALE) which had not been confirmed so far, A. C. D. Crommelin communicates in the July number of "The Observatory" a letter from the discoverer stating that the comet was observed for a month by several Australian observers. But no positions were available yet so that the course of this comet remains unknown.

The writer has worked on the orbit of COMET 1935 *d* (VAN BIESBROECK) and determined a set of elements which fitted the observations over many months. This made it possible to secure a close prediction of the location at the present time. A request for observations to the Lick and Bergedorf Observatories met with ready response and both institutions reported that the comet, of magnitude 16-17 was still in reach of the powerful reflectors used there. This extends the visibility to more than two years and makes it probable that further observations of this very distant comet will be possible. The comet is within 7° of the pole in the beginning of October and reaches the high declination of 86° in the middle of November.

Williams Bay, Wisconsin, September 15, 1937.

Some Observations of Finsler's Comet

These observations of Finsler's Comet were made during its period of naked-eye visibility in August, 1937. The instruments used were two. The first was a 3-inch refracting telescope. This was used with a low-power ocular giving a magnification of 35 diameters and a field of view about one degree across. The other instrument was a pair of cheap field glasses of one-inch aperture, six diameters magnification, and a field of view about five degrees across. Notes on the observations for each night follow.

August 3. Comet just barely visible to naked eye, but easily picked up with the field glasses. Magnitude 5.8. Head was about 12′ across, with a bright central condensation 4′ in diameter. Could trace the main tail about a degree away from the coma. There seemed to be a secondary about 20′ in length, not very conspicuous.

August 4. Magnitude 5.2. The coma had a diameter of about 13′, with the central condensation about 4′ in diameter. A semi-stellar nucleus of about magnitude 8 could be seen. The main tail was about two and a half degrees in length and eight minutes wide. The secondary tail was much fainter than on the night before. These observations were made with 3-inch telescope.

August 5. Magnitude 4.7. Coma 10′ in diameter, brighter and more condensed than on previous night. Nucleus of magnitude 7.6. Tail two degrees long, less conspicuous than on previous night. I could see several 9th and 10th magnitude stars through the tail. The 3-inch telescope was used.

August 6. Magnitude 4.3. The field glasses were used. The night was cloudy, and the comet was observed through gaps in the clouds. The comet, except for being brighter, was practically unchanged from the previous night.

August 7. Magnitude 4.0. Telescope used. The coma had a diameter of 10′ with a bright central condensation of 5′ diameter. The tail was two and a half

degrees long and was more spread out than on previous nights.

August 9. Magnitude 3.6. Field glasses used. The clouds caused a good deal of trouble. The coma had a diameter of 10′. The tail was two and one-half degrees long and slightly curved.

August 11. Magnitude 3.9. Field glasses used. The coma was about 12′ in diameter with a bright central condensation. The tail was about four degrees long, and bright on the following edge near the coma. The tail was about a third of a degree wide at the far end and was wider and fainter than on August 9.

August 12. Fairly bright moon gave some trouble. Magnitude 4.1. Field glasses used. The head was about 12′ in diameter. The bright central condensation was not so conspicuous as on the previous night. The tail was about three degrees long, somewhat curved and wider than on the previous night.

August 13. The moonlight was troublesome. The magnitude of the comet was 4.2. The head about 12′ in diameter, but the central condensation was weaker than on the 12th. The tail was two degrees long, somewhat curved, and fairly wide. The field glasses were used.

August 14. Magnitude 4.5. The field glasses were used. The coma was 10′ in diameter, with the central condensation conspicuous again. Owing to the moonlight, the tail could not be traced far from the head.

August 15. Magnitude 4.8. The coma appeared to be unchanged from the previous night but, owing to the moonlight, not a trace of the tail could be seen. The field glasses were used.

NOAH W. MCLEOD.

Christine, North Dakota, August 17, 1937.

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

For the first time since these Notes were begun, copy apparently has been lost between the writer and the publisher. Consequently the Notes were lacking in the preceding issue. The present Notes will, however, contain tabular matter dealing with the 1937 maximum of the Perseids, which was submitted by volunteer observers not members of the A.M.S. A brief discussion of them will follow, particularly comments on some of the mistakes made by persons in reporting who are nevertheless most willing to observe in the best manner but who are not fully instructed. The data sent in by our A.M.S. members, some of which by the way are not here yet, will be given later, along with such final conclusions as may be drawn from all the combined reports.

Besides the 166 reports which follow, there are about a score of others containing from 2 to a dozen meteors each, but made in such a way that they are wholly useless for a discussion of rates. These are omitted. In the table, it is to be noted that only the rates are given, *not* the corrected rates even when the correction factor F is available. However, these latter may be found by dividing the rate by F. Only very cloudy weather at the maximum, which unfortunately extended over much of this part of the country, as well as elsewhere to a lesser degree, prevented scores of others from observing. This year the request for volunteers was carried by newspapers all over the United States, and the campaign was helped by the radio as well. Considering the weather, the response was rather gratifying; further we have the satisfaction of knowing some hundreds of people

have thus become actively interested in the subject of meteors and astronomy in general.

Station and Observer	Aug.	Began	End.	Min.	Met.	F.	Rate	Note
Huntsville, Ala., L. Harris	11-12	8:50	10:10	80	16	...	16	
New Market, Mrs. H. C. Jones	11-12	8:45	9:30	45	18	...		1
Phoenix, Ariz., J. E. Doyle	11-12	11:	17:		23	...		8
" J. E. Doyle	12-13	11:	17:05		27	1.0		8
" Miss L. Cooper	9-10	10:	10:30	30	6	...	12	
" D. F. Brinegar	11-12	10:	10:45	15	12	0.9	48	
" L. Z. Holzworth	11-12	13:30	16:00	30	17	...	34	
Whiteriver, Miss I. Donner	11-12	14:15	14:45	30	17	1.0		2
" Miss I. Donner	12-13	12:00	12:15	15	8	1.0		2
Keans Canyon, A. R. Hipkoe	11-12	10:	12:15	135	71	...	32	13
Cave Creek, Mrs. F. W. Wright	11-12	10:40	13:00	140	109	...		5
Globe, Mrs. E. L. Kellner	11-12	12:00	13:00	60	11	0.4	11	
Prescott, D. B. Treat	11-12	10:00	12:00	120	62	...	31	
Globe, Miss E. J. Kellner	11-12	12:00	13:00	60	20	0.4	20	
Payson, Miss M. Clark	11 ?	12:15	13:30	75	22	...	16	
" (?)	11 ?	12:15	14:00	105	28	1.0	16	
" (?)	12 ?	12:	14:	120	55	0.8	28	
Patterson, Calif., J. C. Stanley	11 ?	8:	9:	60	12	...		1
Salida, E. B. Griswold	11-12	8:30	10:30	120	24	...	12	
Berkeley, Miss M. Robinson	11-12	9:30	10:	30	11	1.0	22	
Stockton, Mrs. R. C. McGee	11-12	9:	10:	60	17	...		3
" Miss G. Davis	11-12	9:	10:	60	21	0.8	21	
" Miss C. Stinson	11-12	8:30	11:30	180	30	...		2
Taft, H. L. Snyder	11-12	11:30	12:30	60	24	...	24	
Gridley, W. Johnson	12-13	10:00	11:00	60	47	...	47	
Lake Tahoe, E. Baldwin	12-13	11:	12:	60	20	...	20	
Tracy, H. E. Moore	11 ?	8:37	9:09	32	11	...	22	
Bakersfield, O. L. Miles	10-11	8:41	9:08	27	13	...	27	
Lodi, F. H. Watson	9-10	11:25	12:25	60	57	...	57	
Saybrook, Conn., S. Justa	11-12	9:30	10:35	65	17	0.9	14	
Washington,D.C., Miss A. E. Getty	11-12	9:45	12:28	163	23	0.5	8	
Marianna, Fla., T. De Vane	11-12	9:30	10:15	45	10	...		2
Jacksonville, H. Havens	11 ?	10:30	11:30	60	30	...		4
" E. B. Johns	11-12	12:15	13:15	60	33	1.0	33	
Clearwater, A. L. Brown	11-12	11:	13:30	130	43	0.7	20	
" C. G. Crowley	11-12	11:00	12:	60	18	0.7	18	
W. Palm Beach, E. Cavenagh	11-12	9:45	12:00	135	25	...		8
Pensacola, Lt. D. A. Long	11 ?	9:45	11:	75	38	...	30	
Daytona Beach, R. E. Stevens	11-12	12:35	16:15	220	134	1.0	36	9
Augusta, Ga., Mrs. M. Wolff	11-12	11:	11:30	30	7	...	14	
Chickamauga, F. P. Wright	11-12	9:	14:	300	129	...	26	
Washington, L. Johnson	11-12	12:15	13:15	60	50	...		3
Woodstock, D. Power	11-12	9:15	11:35	105	50	1.0	29	
Atlanta, R. Pittard	11-12	11:00	15:00	240	82	0.9	20	
Emory Univ., Miss M. M. Trimble	11-12	11:03	12:03	60	26	...		2
Albany, Miss L. Lowe	11-12	9:40	11:	80	40	...	30	
Valdosta, W. P. Yarbrough	12-13	10:	12:	120	60	...	30	
Chicago, Ill., W. B. O'Connell	12-13	12:50	13:15	25	16	...	38	
Collinsville, Mrs. B. C. Millica	11-12	8:05	9:05	60	11	...	11	
Clinton, Iowa, K. P. Gordon	11-12	11:20	11:50	30	14	0.9	28	
Harlan, Rev. F. E. Eastborn	11-12	9:25	10:25	60	63	...		
" Rev. F. E. Eastborn	12-13	12:15	12:30	15	7	...	28	4
Pierson, F. J. Gilbride	12-13	12:	13:	60	33	1.0	33	
Council Bluffs, Miss R. Johnson	11-12	10:30	11:30	60	19	...	19	
Acton, Ind., J. W. Stevens	11-12	9:00	9:50	50	14	0.9	17	
Mooresville, R. H. Storm	12-13			50	9	...		1
New Albany, E. Williams	11-12	7:30	10:02	92	14	0.8	10	
Kinsley, Kan., Miss N. Whitnah	11-12	10:	16:30	300	166	1.0	33	
Humboldt, Miss M. Johnson	11-12	10:	13:	180	227	1.0		6

Station and Observer	Aug.	Began	End.	Min.	Met.	F.	Rate	Note
Parsons, J. P. White	11 ?	9:	11:	120	87	0.8		3
Caney, R. C. McQuillan	11-12	9:	12:	180	131	0.7	44	
Topeka, Dr. E. M. Wiedermann	11-12	12:12	13:15	63	9	0.6	9	
Great Bend, R. Barns	11 ?	10:29	11:29	60	30	0.7		1
Garden City, J. Curtis	11-12	8:32	9:32	60	28	...		1
Orono, Maine, W. J. Sweetzer	11-12	10:	11:	60	19	1.0	16	2, 10
Woodlawn Hts.,Md., H. A. Webster	11-12	11:02	11:50	48	28	1.0	35	
Rockport, Mass., Miss A.B.L.Greene	11-12	9:35	10:35	60	18	...	18	
Wilmington, C. Simpson	11-12	10:45	14:45	220	70	0.7		2
E. Boston, J. DiFaria	11-12	9:37	11:57	140	32	...	14	
Melrose, R. Simpson	11-12	10:30	11:30	60	28	...		1
Lexington, P. E. Kyle	11-12	9:00	10:00	60	20	...		1
Ann Arbor, Mich., R. H. Nichols	12-13	11:30	12:30	60	31	0.8	31	
Constantine, W. R. Morris	12-13	9:30	13:	180	67	...	22	
Monett, Mo., R. O. Willard	11-12	9:45	10:45	60	40	...	40	
Jefferson City, Mrs. W. R. Coffing	11-12	9:15	11:15	120	43	...		2
Lexington, J. L. Lowe	11-12	11:	12:	60	65	...		2
St. Joseph, F. F. Holland	11-12	11:	12:	60	32	...	32	
" L. V. Crandall	11-12				47	...		2
Moberly, R. S. Gaspanolle	11-12	9:28	10:28	60	43	...		4
" Miss E. Wisdom	11-12	10:	11:	60	20	...	20	
" C. E. Hendrix	11-12	8:00	10:00	120	45	1.0	22	
" Miss M. W. Jones	11-12	12:45	13:15	30	18	...	36	
Pierre City, Rev. B. N. Mote	11-12	12:17	12:47	30	20	...	40	
Hannibales, J. C. Bowles	11-12	8:00	10:40	160	38	...		2
Robbinsdale, Minn., C. R. Erickson.	11-12			60	60	...		
Beaver Creek, G. H. Schneiderham	11-12	10:35	11:35	60	43	1.0		2
Jackson, Miss., E. B. Sebowin	10 ?	8:	10:	120	8	...	4	
Wibaux, Mont., W. White	11-12	9.	9:30	30	10	...	20	
Dillon, Miss R. L. Smith	11-12	10:50	12:00	70	160	...		6
Miles City, Miss B. J. Hyslop	11-12	11:	11:30	30	42	...	84	
Great Falls, Miss V. Ferrin	11-12	10:	10:45	45	18	...		1
Reno, Nev., Dr. D. A. Turner	11-12	8:20	9:20	60	18	...		2
Gilbert, Mrs. R. Gilbert	12-13	8:	9:	60	7	...	7	
Plaistow, N. H., Miss D. Cheney	11-12	9:15	10:	45	26	...	35	
Atlantic City, N.J., A. S. Webster	11-12	10:32	11:10	38	10	...		3
Albuquerque, N.M., R. Patterson	11 ?	9:00	10:	60	15	...		2
" C. A. Barnhart	11-12	10:04	11:09	65	30	...		2
" C. A. Barnhart	12-13	11:00	12:00	60	46	...		5
" C. A. Barnhart	13-14	14:15	15:15	60	20	...		2
Catskill Mts., N. Y., J. T. Truxton	13-14	11:30	15:30	240	271	...		3, 11
Louisville, Neb., H. B. Koop	10-11	9:	10:	60	22	...	22	
E. Omaha, Mrs. F. E. Kaser	11-12	10:30	11:	30	30	...		2
Omaha, A. Spar	11-12	12:38	13:38	60	78	...		2
Beatrice, F. Thimm	11-12	9:00	10:00	60	29	...	29	
N. Platte, A. M. Christ	11-12	9:05	10:05	60	85	...		7
Omaha, Mrs. G. C. Nelsen	11-12	10:	10:30	30	10	...	20	
" M. M. Steinberg	11-12	9:45	10:45	60	9	...	9	
Grand Island, Mrs. K. Knickrehm	11-12	8:45	10:	75	11	0.7		3
Lincoln, V. O. Gravatt	11-12	9:30	10:30	60	37	...	37	
" V. O. Gravatt	12-13	9:00	10:00	60	17	...	17	
Rockford, D. L. Frantz	11 ?	9:	10:	60	27	0.7	27	
Omaha, F. Hobbs	11 ?	9:	11:	120	36	...	18	
Whitsatt, N. C., Miss D. Yarbrough	9-10	14:30	15:00	30	10	...		1, 8
" Miss D. Yarbrough	11-12	14:	15:	60	48	...		1
Hickory, Miss R. Lawrence	11-12	11:20	12:30	55	42	0.6		2
Winston-Salem, H. R. Borthwick	8- 9	8:30	11:	150	20	...	8	
" H. R. Borthwick	10-11	8:50		60	22	0.4	22	
Cleveland, Ohio, Miss H.P.Sheridan	12-13	10:	14:		25	1.0		8
Youngstown, J. McKinven	11-12	11:	13:10	130	40	0.7	18	
Stillwater, Okla., Prof. R. Stratton	11-12	12:	13:30	60	264	0.9		4
Cheyenne, R. Conrad	11-12	9:23	10:03	40	55	...	83	

Station and Observer	Aug.	Began	End.	Min.	Met.	F.	Rate	Note
Oklahoma City, J. S. Harris	11 ?	9:30	10:	30	12	...	24	
Alester, W. E. Green	11-12	10:20	10:38	18	12	...	40	
Chickasha, J. Guess	11-12	9:55	10:55	60	46	...		5
Fort Sill, Capt. W. D. Williams	11-12	8:30	9:30	60	22	...		4
" Capt. W. D. Williams	11-12	9:45	10:45	60	19	...	19	
Grimsby Beach, Ont., W. C. Jose	11-12	13:32	14:32	60	35	...		2
Johnstown, Pa., W. W. Bailey	11-12	10:15	11:30	75	14	0.7		1
" W. A. Thomas	11-12	11·	12:	60	20	...		2
Philadelphia, E. K. Maurer	10-11	8:45		60	37	...	37	
Kennett Square, F. H. Cutaiar	11-12	17:	17:45	45	9	0.5	12	
Hazelton, Miss M. B. Kimble	11 ?	11:	12:	60	57	...		3
Northumberland, Miss Patterson	11-12	11:	12:	60	98	...		3
Waynesboro, Miss B. F. Mumma	11-12	13:	14:	?	12	...		8
Wilkes Barre, P. F. Winters	11-12	11:10	13:42	152	91	...	36	
Bald Eagle Mt., R. H. Baldwin	11-12	9:55	10:45	50	24	0.8	29	
Regina, Sask., H. E. Rasmussin	10-11	10:45	11:45	60	42	...		3
" H. E. Rasmussin	11-12	10:00	15:00	260	367	...		3
" H. E. Rasmussin	12-13	10:00	12:00	120	109	...		3
Sioux Falls, S. D., E. Zellers	11-12	12:00	13:00	60	68	...	68	
Rapid City, Miss C. K. Snyder	10-11	9:	9:30	30	10	...	20	
Huron, Miss K. Reid	11-12	10:10	10:40	30	20	...	40	
Chattanooga, Tenn., Z. Lowdin	11-12	9:01	10:01	60	15	...	15	
San Benito, Tex., H. K. Livingston	11-12	9:30		60	16	...	16	
Throckmorton, G. K. Euband	11 ?	9:	10:	60	17	...	17	
Amarillo, B. A. Trammell	11-12	13:20	14:40	80	26	0.8	20	12
Uvalde, V. Robey	11-12	11:	12:	60	45	...		2
Gregory, H. F. Pape	11-12	11:55	13:15	80	40	...	30	
Waco, F. Wallace	11-12	9:20		60	10	0.6		3
San Angelo, C. J. Stroman	11-12				25	...		1
Big Spring, Miss N. J. Gray	12-13	9:	11:	120	18	...		1
Nocona, D. Janeway	11-12	10:15	11:15	60	39	...	39	
Big Lake, R. L. Jackson	11-12	10:15	10:50	35	18	...	30	
Murray, Utah, Miss L. Powell	11 ?	12:09	13:09	60	63	...	63	
Arlington, Va., C. E. Lightfoot	11-12	10:00	12:00	120	38	0.7	19	
Fairfax, E. Rust	11-12	8:45	12:05	140	45	...		2
Cheney, Wash., B. C. Parmenter	11-12	9:00	11:00	120	131	...	66	
Hartland, Wis., G. G. Babcock	12-13	8:42	9:42	60	13	1.0	13	
Wausau, Mrs. D. Oatman	11-12	9:	10:	60	56	...		2
Jefferson, Miss R. L. Golz	10-11	11:45	12:45	60	29	...	29	
Appleton, Mrs. A. Furtmanv	12-13	9:40	10:40	60	43	...		1
" Mrs. A. Furtmanv	13-14	10:00	11:00	60	25	...		1
Thienville, V. Spearbrakee	12 ?	12:10	12:30	20	11	1.0	20	
Milwaukee, E. F. Kujawski	12-13	12:10	14:12	122	41	1.0	20	
Buckhannon, W. Va., C. M. Lewis	11-12	10:40	11:40	60	36	0.8	36	
Laramie, Wyo., Mrs. K. G. Turman	11-12	11:00	11:20	20	10	1.0	30	

NOTES

(1) More than one observer. (2, 3, 4, 5, 6, 7) denote number of observers in each case. (8) one intermittent count. (9) 64 meteors plotted. (10) 16 seen by one observer. (11) 180± Perseids. (12) 23 Perseids, 3 others. (13) 63 Perseids, 8 others.

On examining the table it will be seen that no rates can be given for the largest and best organized groups. This is due to the fact that it is next to impossible to induce each observer to count every meteor seen, irrespective of what his companions are doing. A group will not count duplicates thinking that we want the number of separate meteors seen. So we would, if the group could or would see all! They do not realize that it has been computed it would require a trained party of 32 observers, with carefully restricted areas of the sky to watch, to see all meteors visible from one station. We urge always that each observer count all he

sees, for our unit is the number seen per hour for one observer. But, in general, two observers do not see twice as many different meteors as one (there are some duplicates), nor do three see three times as many as one, etc, etc. Hence for the excellently organized groups of from 3 to 7 observers, who sent in their combined and unduplicated counts, there is no earthly way for us to derive the unit rate! Most of the observers failed to tell the condition of the sky: it may be inferred it was clear in most cases or they would mention the contrary. Several failed to give the date: sometimes the postmark supplied this want. The double date, as August 11-12, should always be used, no matter what the hour of the night, to avoid ambiguity. Here the endeavor has been made to print only such data as were actually reported, hence the number of gaps in the columns. It is gratifying to see how many states are represented, 37, and two Canadian provinces. States not mentioned here will in some cases be included in the A.M.S. members' reports. The large number of women who took part is also a thing well worth remarking. Only the name of the person signing the report is given, to save space. We thank most heartily the several hundred people who took part in this campaign, thus helping to increase our knowledge of these most interesting meteors.

In closing let me call attention to the Orionids of October, active from October 14 to 28 at least; and the Leonids of November, probably active though in small numbers this year from November 12 to 18. The Bielids have totally disappeared as a stream. But observations of the two others just mentioned, for as many nights as possible, are urged upon our members and others interested in meteors. In fact, throughout all the fall months there are enough meteors visible on the average night after 11:00 P.M. to well repay work, and further knowledge of the minor radiants, as well as the principal ones, is badly needed. The activity of many of our members has gone steadily down for the past two years: this fall would be an excellent time to make new resolutions and carry them into effect. We would like especially to hear from several of our regional directors from whom no work has come in 1937.

1937 August 28, Flower Observatory, Upper Darby, Pennsylvania.

A Peculiar Hole Near Tiffin, Iowa

By C. C. WYLIE

Some four years ago, Mr. G. M. Ludwig, Superintendent of schools at Tiffin, Iowa, purchased a farm near that village. On this farm, he found a peculiar hole in the bottom lands of Clear Creek, which flows across the farm. Tradition called it a buffalo wallow, but University men familiar with the buffalo, said that, in their opinion, it could not be a buffalo wallow. Another suggestion was that it might be a sinkhole. However, there are no known sinkholes in the region, and bedrock is more than 100 feet below the bottom of the hole in question. Mr. Ludwig did not believe that ordinary stream flow and erosion could account for the hole.

Mr. Ludwig approached us to inquire whether the hole in question might be a meteoric crater. There was no apparent reason for assuming that the hole is meteoric, but since no other suggested explanation appeared reasonable, it was decided that a study of the hole should be made. To differentiate intelligently between meteoric and pseudo-meteoric craters, it is essential that holes resembling

meteoric craters be studied. Geologists should develop the explanation for such rather completely.

Description of the Depression

The hole in question is an elliptical depression about 100 feet in length and 75 feet in width. The bottom of the hole is about 8 feet below the surrounding bank. The long axis lies approximately southeast by northwest, the bank being higher to the southeast.

An ordinary rain puts comparatively little water in the depression, as the area of drainage basin is only two or three times that of the hole. The hole is filled only when Clear Creek, about 150 feet away, overflows. When the creek does overflow, it fills first an old oxbow loop, marked A in Figure 1. This shallow loop overflows across B, and into the hole at the small gulley marked C. The repeated overflowing of the creek has cut this gulley where the water runs into the hole. When the overflow has filled the oxbow loop, and also the hole, the water over-

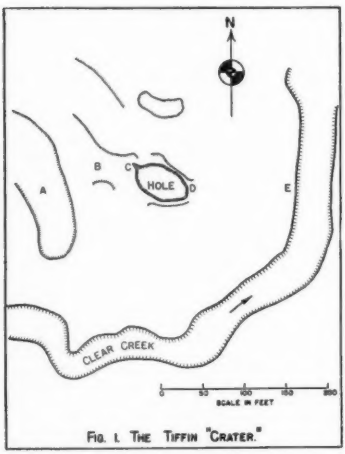


Fig. 1. The Tiffin "Crater."

Figure 1

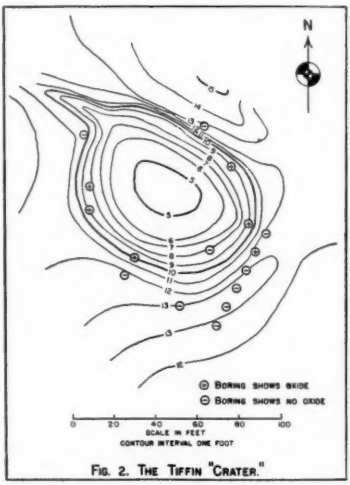


Fig. 2. The Tiffin "Crater."

Figure 2

flows at the point D, and, crossing the level bottom lands, it returns to the creek at the point E. There is no gully, or wash, whatever along the line D-E, as the water goes across here only when the bottom lands are completely flooded. The narrow and steep inlet gulley on the northwest, and wide overflow on the east, are shown in the contour map, Figure 2.

Trees on the rim include one cottonwood, three willows, three birches, four walnuts, and seven elms. Probably not a tree on the rim or in the immediate vicinity is as much as 50 years old.

In the dry year, 1934, the creek did not overflow at all and this depression was empty throughout the summer. The spring of 1935, however, was wetter and the creek overflowed into the depression three times; once in April, and twice in June. It was the opinion of those who saw the hole before and after these overflows, that they increased the size of the inlet gulley considerably, and washed a noticeable amount of silt into the depression. If a single wet year makes such a

noticeable change, the depression can hardly be 100 years old, or the repeated overflows would have made the inlet gulley much larger and filled the depression with silt.

The depression does not look artificial and there is no apparent reason for man making such a hole in the bottom lands near a creek. The shape is somewhat like a large pond, except that a pond normally has a dam and a reasonable drainage basin. This depression has no dam and such a small drainage basin that it is valueless as a reservoir of water, being empty in dry weather; while even in dry weather there is plenty of water in the nearby creek.

Such depressions are not uncommon in glacial drift, but, in this case, the glacial theory cannot be considered. The hole is not old enough, and it is not in glacial drift, but in soil overlying such drift.

Let us now consider the possibility of a meteoric origin. The hole or "crater" is so small that the vaporization of little more than a ton of meteoric material might have produced it. However, a meteorite weighing only a ton would not strike the ground with sufficient velocity for vaporization. Hence, if a crater of that size was produced by a meteorite, we must assume that an object weighing several tons struck. The striking velocity was sufficient to shatter the object, but to vaporize only a small portion of it.

If this hole were meteoric and over bedrock, a trench cut across the hole would show conspicuous effects of the explosion. On either side of the hole and at a short distance, the soil would be underlaid by undisturbed rock. Underneath the hole, the rock would be shattered. We would expect considerable shattering of the underlying rock, even though an explosion might throw very little rock where it is overlaid with ten feet of soil.

In the case of this hole at Tiffin, however, the soil is underlaid by glacial sand and gravel, rather than by bedrock. A meteor such as we have imagined, weighing several tons and striking with a velocity sufficient to shatter it and vaporize a ton or so of the material, would presumably throw up a certain amount of the underlying gravel and glacial drift. The stones and gravel would fall back into the hole along with any fragments of the shattered meteor. However, a trench cut across the hole and dug down to the underlying gravel and glacial drift should show definite evidence of the explosion.

The vaporization of the meteoric material would mean the vaporization of a certain amount of iron. Even the stone meteorites normally include a considerable amount of iron. The soil falling back after the explosion would entangle a considerable amount of the iron vapor. Probably many little droplets of meteoric iron would be intermingled with the soil. In a very short time the meteoric iron in the rim of such a crater would be oxidized. The only evidence remaining would be the presence of iron oxide in the surrounding soil.

The Investigation

Messrs. M. E. Nelson and D. E. Yarnell, engineers from the Hydraulics Laboratory, examined the hole and its surroundings. Their opinion was that it could not have been formed by the ordinary processes of stream flow and erosion.

Professors Bohumil Shimek and Homer R. Dill were consulted on the possibility of the hole being a buffalo wallow. They reported that the buffalo was an animal of the plains, and that there were no records of herds in the wooded bottom lands where this hole is located. Further, the hole is so large that only an enormous herd could have made it. They were quite sure that it was not made by buffalo.

Another suggestion was that the depression is a sinkhole. However, the material underlying these bottom lands is glacial drift. Nearby wells indicate that bedrock is more than 100 feet below the bottom of the creek bed and the bottom of this hole. Clear Creek is never dry, and the sand and gravel below the hole are continuously saturated with water. Excepting for this depression, the bottom lands of the creek are reasonably level. Numerous old oxbow loops on both sides of the depression show that the creek has crossed over the site of the hole many times in past centuries. Consequently, if a person assumes that underground channeling is the explanation of the hole, he must assume channeling in glacial drift which is well below the water table, and continuously saturated. He must assume the formation of the sinkhole at a point which undoubtedly has been crossed by the creek many times in recent centuries. This does not appear reasonable.

We have said that a trench dug across the depression, and down to the underlying glacial drift, should give evidence on whether or not the hole is meteoric. In this case, the digging of such a trench was impractical. While the investigation was in progress, a heavy rain caused the creek to overflow and fill the hole. When the creek returned to its normal level, the water was siphoned out of the hole, using a one-inch hose of sufficient length to reach across the 150 feet from the hole to the creek. The sides and bottom of the depression were, naturally, saturated with water and any hole dug in the bottom filled with water immediately. It might have been possible to dig a useful trench toward the end of the drought in 1934, but in an average year it could not be undertaken without a power pump.

Since trenching was impractical, borings with a soil auger were made instead. These borings showed that most of the rim of the hole has a reddish clay, or other clay containing oxide. At the top of the rim, the reddish clay is, in general, only about five inches below the sod. As one leaves the rim in every direction, the borings must be deeper to strike the clay. At a distance of only a few feet outside of the rim, borings as deep as 36 inches show no red clay or oxide. On Figure 2 the location of the borings in and near the hole is indicated. A+ indicates that oxide was found, and a — indicates that no oxide was found. Some random borings were made farther from the hole than any shown on the plot. None of these showed any oxide.

Probings in the bottom of the hole, with iron rods, indicated that the hole is filled, to the depth of about six feet, largely with silt. There is considerable gravel at a depth of about four feet below the bottom of the hole, but, in most places, a rod could be pushed down rather readily to a depth of about six feet before the gravel was sufficiently dense to stop the rod. In some places, the rod could be pushed down to a depth of more than six feet. Probings at different places in the bottom showed little difference in depth. A level line from the hole to the creek indicated that the gravel below the hole is at approximately the same depth as the gravel at the bottom of Clear Creek. However, the gravel at the bottom of Clear Creek is, at all places, so densely packed that a probing rod cannot be pushed into it.

The presence of the oxide in the rim of the crater is a small point in favor of the meteoric theory. The probing-rod results for depth of gravel over the bottom of the hole seem to be against that theory.

This depression is located a little more than half a mile east, and about a quarter of a mile south of the village of Tiffin, Iowa. The longitude and latitude are approximately 91° 42′ West, and 41° 42′ North.

Figure 1 shows the relation of the depression to Clear Creek. Figure 2 is a larger scale contour map. The figures show the height above the gravel in the

bottom of the creek. The measurements on which these maps are based, and the soil borings, were made by Dr. L. R. Wylie and Bemrose Boyd.

SUMMARY

Any theory formulated to explain this hole must take into consideration the following facts.

The location and appearance of the hole are arguments against its having been made by man.

The location and size are arguments against its having been made by buffalo.

The hole is probably less than 100 years old. The small size of the inlet gulley, the relative youth of the trees on the rim and the depth of the silt in the bottom of the hole are all arguments against a great age.

The old oxbow loops on both sides of the depression indicate that the stream has crossed the site several times.

Experts believe that the ordinary processes of stream flow and erosion did not produce the hole.

The gravel underlying the hole is at about the same level as the gravel of the nearby creek bottom. It is saturated with water, and is packed less densely than the gravel of the creek bottom. Bedrock is more than 100 feet below the bottom of the hole and the bottom of the creek. The creek is here flowing over glacial drift.

Soil borings on the rim of the hole show oxide at a depth of about five inches. Borings at a distance of only a few feet from the rim show no oxide within three feet of the surface.

University of Iowa, September 16, 1937.

Contributions of the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD,
Department of Astronomy, University of California at Los Angeles

President of the Society: H. H. NININGER, Colorado Museum of Natural History and American Meteorite Laboratory, Denver

Secretary of the Society: ROBERT W. WEBB, Department of Geology, University of California at Los Angeles

Meteorite Discoveries Reported to the Society for Research on Meteorites from August, 1933, to June, 1937*

By ADDIE D. NININGER,
Assistant Secretary of the Society, 1934-37

Acting under the instructions of President Frederick C. Leonard,[1] the Secretary and the Assistant Secretary have been compiling all authentic reports of meteorite discoveries, in so far as it has been possible to secure these reports from all parts of the world, for the purpose of bringing up to date the list of meteoritic falls published in the Appendix to *Our Stone-Pelted Planet*, pp. 141-232 (by H. H.

*Read at the Fifth Annual Meeting, Colorado Museum of Natural History, Denver, June 22 and 23, 1937.

[1] See the President's address at the Second Annual Meeting, *N.S.R.M., P. A.*, 42, August-September, 1934 (p. 398, third paragraph).

Nininger, Houghton Mifflin Co., 1933). Not all of the countries have as yet responded to our requests. However, the spirit of coöperation has been gratifying in all of those instances in which replies have come in. The effort will be continued until all of the various countries have been heard from, if such a result is possible.

A summary of the results so far reveals that 24 observed falls may be added to the published compilation referred to in the preceding paragraph, and 76 finds of unwitnessed fall. Of the 24 witnessed falls, 17 are stones, 5 are irons, and 2 are stony-irons. Of the finds of unwitnessed fall, 53 are stones, 20 are irons, and 4 are stony-irons. It will be noticed that among the observed falls, the ratio of irons to stones is somewhat higher than in lists previously published. It will be noticed further that among the finds, the ratio of stones to irons is very much higher than in the older lists. This change has resulted undoubtedly from the planned search which has been carried on during recent years in the middle western United States.

The present total of recorded meteorite falls, both witnessed and unwitnessed, which the Secretary's office has been able to compile, is 1,127. 556 of these are witnessed falls and 571 are finds of unwitnessed fall. The Secretary does not vouch for the authenticity of all of the falls recorded in this list. Where published catalogs, such as those of G. T. Prior, O. C. Farrington, and the U. S. National Museum, have recorded discoveries, these have been taken as published. Also, when lists have been submitted by leading students of meteorites in various countries, we have adopted their reports.

Of the 100 falls which have lately been reported (see the following catalog), it is interesting to note that most are for the years 1933 to 1937. Taking these falls by single years, we find that, in 1933, 16 new falls were reported, of which 14 are stones and 2 are irons. 6 of the stones and 1 iron were seen to fall. In the year 1934, 17 falls were reported, of which 12 are stones, 4 are irons, and 1 is a stony-iron. Of these the stony-iron was seen to fall, as were also 1 iron and 4 stones. In 1935, 16 new falls were reported, of which 8 are stones, 5 are irons, and 3 are stony-irons. One of each of the three kinds of meteorites was seen to fall that year. In the year 1936, 23 falls were reported, of which 19 are stones, 3 are irons, and 1 is a stony-iron. All of these were finds, except one stone. In 1937 so far, 8 falls have been reported, of which 7 are stones and 1 is an iron, all finds.

Of the 100 meteoritic falls reported since the Appendix (*op. cit.*) was published in 1933, 78 are within the United States, while the remaining 22 are in all of the other countries combined. It may be interesting to note that 54 of the 100 falls were found by the Nininger Laboratory (now called the American Meteorite Laboratory). Another interesting fact is that 2 meteorites were seen to fall on the same day, one a stone, which fell in Sioux County, Nebraska, on August 8, 1933, at 10:30 A.M., the other an iron, which came down in Russia. The time of day was not stated in the latter case.

Since the first meteorite was recorded 130 years ago, 1,127 falls have been reported—or, on the average, 8.6 per year. In the last 4 years, 100 new falls have been recorded—or, on the average, 25.5 per year. This great augmentation is due evidently to the increased attention which has been paid to the subject of meteorites in the course of this short time. It may be mentioned also that the year 1933 was the year the Society for Research on Meteorites was organized and that one of the stated purposes of this organization is "to promote the discovery, collection, investigation, and preservation of meteorites" (*Constitution*, Art. I, Sec. 2).

FIRST CATALOG OF METEORITE DISCOVERIES REPORTED TO THE SOCIETY FOR RESEARCH ON METEORITES: AUGUST, 1933, TO JUNE, 1937[2]

[The falls are numbered in the order in which they have been reported.]

1. Silverton, South Australia. Stone. Found (?). Wt. 12 oz. One stone.
2. Pfullingen, Tübingen, Württemberg, Germany. Iron. Fell 1904 Oct. 29, 4:00 P.M. Wt. 7.5 kg. (16.5 lb.). One mass.
3. Kirbyville, Jasper Co., Texas. Stone. Fell 1905. Wt. 97.7 g. One stone.
4. Shrewsbury, York Co., Pennsylvania. Iron. Found 1907. Wt. 12.2 kg. (27 lb.). One mass.
5. Colomera, Granada, Spain. Iron. Found 1912. Wt. 134 kg. (294 lb.). One mass.
6. Moore Co., North Carolina. Stone. Fell 1913 Apr. 21, 5:00 P.M. Wt. 1.9 kg. (4 lb., 2 oz.). One stone.
7. Norfork, Baxter Co., Arkansas. Iron. Fell 1918 Oct. Wt. 1050 g. One mass.
8. Lake Labyrinth, South Australia. Stone. Fell 1924. Wt. 35 kg. (75 lb.). Several fragments.
9. Alice Springs, Central Australia. Pallasite. Found 1924. Wt. 1.084 kg. (2.3 lb.). One mass.
10. York, York Co., Nebraska. Stone. Found 1928. Recognized 1936. Wt. 1440 g. One stone.
11. Kappakoola, Eyre Peninsula, South Australia. Stone. Found 1929. Wt. 392 g. One stone.
12. Beverbrück, Cloppenburg, Oldenburg, Germany. Stone. Fell 1930 Sep. 10, 2:15 P.M. Wt. 16.58 kg. (36.4 lb.). 2 stones.
13. Henbury, Central Australia. Iron. Found 1931. Wt. (?). Innumerable masses.
14. Doyleville, Gunnison Co., Colorado. Stone. Found 1887. Recognized 1931. Wt. 112 g. One fragment preserved.
15. Bear Lodge, Weston Co., Wyoming. Iron. Found 1931. Wt. 48.6 kg. (106.9 lb.). One mass.
16. Alikatnima, Central Australia. Iron. Found 1932. Wt. 16 kg. (35 lb.). 3 masses.
17. Kuznetzovo, West Siberia. Stone. Fell 1932 May 26. Wt. 23 kg. (51 lb.). 8 stones.
18. Deport, Red River Co., Texas. Iron. Recognized 1932. Wt. 15 kg. (33 lb.). Several masses.
19. Boerne, Kendall Co., Texas. Stone. Found 1932. Wt. 1.1 kg. (2.5 lb.). One stone.
20. Kyancutta, Eyre Peninsula, South Australia. Iron. Found 1932. Wt. 32.2 kg. (72 lb.). One mass.
21. Melrose, Curry Co., New Mexico. Stone. Found 1933. Wt. 59.5 kg. (130 lb.). 6 stones.
22. Pasamonte, Union Co., New Mexico. Stone. Fell 1933 Mar. 24, 5:05 A.M. Wt. about 4 kg. (9 lb.). 80 stones.
23. Harrisonville, Cass Co., Missouri. Stone. Found 1933. Wt. 12.9 kg. (28.4 lb.). 14 stones.
24. Cherokee Springs, Spartanburg Co., South Carolina. Stone. Fell 1933 July 1, 9:42 A.M. Wt. 8.4 kg. (18.5 lb.). 2 stones.
25. Sioux Co., Nebraska. Stone. Fell 1933 Aug. 8, 10:30 A.M. Wt. 4.1 kg. (9 lb.). 20 stones.
26. Logan, Beaver Co., Oklahoma. Stone. Found 1918. Recognized 1933. Wt. 1315 g. One stone.
27. Athens, Limestone Co., Alabama. Stone. Fell 1933 July 11, 9:30 A.M. Wt. 264 g. One stone.
28. Repeev, Khutor, Volga Dist., U.S.S.R. Iron. Fell 1933 Aug. 8. Wt. 7 kg. (15.4 lb.). One mass.
29. Lebjagevka, Siberia. Stone. Fell 1933. Wt. (?). Several fragments.
30. Ivanovo, 200 km. east of Moscow, U.S.S.R. Stone. Fell 1933. One 8-kg. mass and 70 other fragments.

[2] The compiler will be grateful to be informed of any errors of omission or commission found in this catalog.

31. Marsland, Dawes Co., Nebraska. Stone. Found 1933. Wt. 4.6 kg. (10.25 lb.). One stone.
32. Morrill, Sioux Co., Nebraska. Iron. Found 1920. Recognized 1933. Wt. 1387 g. One mass.
33. Loomis, Phelps Co., Nebraska. Stone. Found 1933. Wt. 3.02 kg. (6 lb., 11 oz.). One stone.
34. Grady, Curry Co., New Mexico. Stone. Found 1933. Wt. 4234 g. One stone.
35. Gretna, Phillips Co., Kansas. Stone. Found 1912. Recognized 1933. Wt. 59 kg. (130 lb.). 2 fragments.
36. Hobbs, Lea Co., New Mexico. Stone. Found 1931. Recognized 1933. Wt. 2.3 kg. (5 lb.). One stone.
37. Cleburne, Johnson Co., Texas. Iron. Found 1907. Recognized 1934. Wt. 6.8 kg. (15 lb.). One mass.
38. La Rinconda, Sevilla, Spain. Pallasite. Fell 1934 July 17. Wt. 8 g. One mass.
39. Salisbury, South Africa. Stone. Fell 1934 Mar. 4, 12:45 P.M. Wt. 27.2 kg. (60 lb.). One stone.
40. Kearney, Kearney Co., Nebraska. Stone. Recognized 1934. Fell probably in June, 1932. Wt. 1101 g. One stone.
41. Tryon, McPherson Co., Nebraska. Stone. Recognized 1934. Wt. 13.7 kg. (30 lb.). Many fragments.
42. Roy, Harding Co., New Mexico. Stone. Found 1934. Wt. 50 kg. (110 lb.). One stone, broken.
43. Tequezyuito Creek, Harding Co., New Mexico. Stone. Found 1934. Wt. about 12 lb. One stone.
44. Tirupati, Chittoor Dist., Madras, India. Stone. Fell 1934 Mar. 20, 6:30 P.M. Wt. 230 g. 5 stones and several fragments.
45. Bahjoi, Moradabad Dist., U. P., India. Iron. Fell 1934 July 23, 9:30 P.M. Wt. 10.32 kg. (22.7 lb.). One mass.
46. Lost Lake, Alamosa Co., Colorado. Stone. Found about 1931. Recognized 1934. Wt. 11 g. One stone.
47. Farmville, Pitt Co., North Carolina. Stone. Fell 1934 Dec. 4. Wt. 56 kg. (123 lb.). 2 stones.
48. Fayetteville, Washington Co., Arkansas. Stone. Fell 1934 Dec. 26, 11:20 A.M. Wt. 2.4 kg. (5 lb., 4 oz.). 2 stones.
49. Spearman, Hansford Co., Texas. Iron. Found 1934. Wt. 10.4 kg. (23 lb.). One mass.
50. Willow Creek, Natrona Co., Wyoming. Iron. Found about 1914. Recognized 1934. Wt. 51.2 kg. (112.5 lb.). One mass.
51. Weldona, Morgan Co., Colorado. Stone. Found 1934. Wt. 22.7 kg. (49.9 lb.). One stone.
52. Gruever, Hansford Co., Texas. Stone. Found 1934. Wt. 11.1 kg. (24.4 lb.). One stone.
53. Ulysses, Grant Co., Kansas. Stone. Found about 1929. Recognized 1934. Wt. 3.1 kg. (6.8 lb.). One stone.
54. Osseo, Ontario, Canada. Iron. Found 1935. Wt. 50 kg. (110 lb.). One mass.
55. Clareton, Weston Co., Wyoming. Stone. Found 1935. Wt. 1050 g. One stone.
56. Hugoton, Stevens Co., Kansas. Stone. Found 1935. Wt. 340.4 kg. (749 lb.). One stone. 5.5 kg. (12 lb.) found later.
57. Holyoke, Phillips Co., Colorado. Stone. Found about 1933. Recognized 1935. Wt. 5.5 kg. (12 lb.). One stone.
58. Quartz Mt., Nye Co., Nevada. Iron. Found 1935. Wt. 4.8 kg. (10.5 lb.). One mass.
59. Perpeti, Tippera Dist., Bengal, India. Stone. Fell 1935 May 14, 11:00 P.M. Wt. 23.5 kg. (51.7 lb.). At least 14 stones, the largest, wt. 6.9 kg. (15 lb.).
60. Phillips Co., Colorado. Pallasite. Found 1935. Wt. 1.3 kg. (3 lb.). One mass.
61. Morland, Graham Co., Kansas. Stone. Found 1935. Wt. 283.2 kg. (623 lb.). One broken stone.
62. Mallorca, Spain. Iron. Fell 1935 July 17. Wt. 809 g. One mass.
63. Patwar, Tippera Dist., Bengal, India. Pallasite. Fell 1935 July 29, 2:20 P.M. Wt. 37.35 kg. (82 lb.). 5 masses, the largest, wt. 23.11 kg. (50.8 lb.).
64. Clarendon, Donley Co., Texas. Iron. Found 1935. Wt. 3 kg. (6.5 lb.). One mass.

65. Hawk Springs, Goshen Co., Wyoming. Stone. Found 1935 Dec. 23. Wt. 367 g. 3 stones.
66. Pleasanton, Linn Co., Kansas. Stone. Found 1935. Wt. about 5 lb. One stone.
67. Bennett Co., South Dakota. Iron. Found 1935. Wt. 89 kg. (196 lb.). One mass.
68. Albin, Laramie Co., Wyoming. Pallasite. Found 1915. Recognized 1935. Wt. 37.6 kg. (83 lb.). One mass.
69. Oberlin, Decatur Co., Kansas. Stone. Found about 1911. Recognized 1935. Wt. 2.5 kg. (5.5 lb.). One stone.
70. Seneca, Nemaha Co., Kansas. Stone. Found 1936. Wt. 1.9 kg. (4.1 lb.). 2 fragments.
71. Adrian, Deaf Smith Co., Texas. Stone. Found 1936. Wt. 6.3 kg. (14 lb.). One stone, broken. A second stone found later, wt. 16.3 kg. (36 lb.).
72. Channing, Hartley Co., Texas. Stone. Found 1936. Wt. 15.3 kg. (33.75 lb.). One stone, broken.
73. Hale Center, Hale Co., Texas, No. 1. Stone. Found 1936. Wt. 695 g. One stone.
74. Hale Center, Hale Co., Texas, No. 2. Stone. Found 1936. Wt. 610 g. One stone.
75. Shallowater, Lubbock Co., Texas. Stone. Found 1936. Wt. 4.7 kg. (10.3 lb.). One stone.
76. Gladstone, Colfax Co., New Mexico. Stone. Found 1936. Wt. 57.3 kg. (126.7 lb.). 3 stones.
77. Ute Creek, Union Co., New Mexico. Stone. Found 1936. Wt. 2 kg. (4.5 lb.). Several fragments.
78. Farley, Colfax Co., New Mexico. Stone. Found 1936. Wt. 19.8 kg. (43.5 lb.). 2 stones.
79. Arriba, Lincoln Co., Colorado. Stone. Found 1936. Wt. 15 kg. (33 lb.). One stone, broken into 3 pieces. Later 3 additional stones were found, wt. 9.9 kg. (20 lb.); 2.9 kg. (6.5 lb.); 2.8 kg. (6.25 lb.), respectively.
80. Hugo, Lincoln Co., Colorado. Stone. Found 1936. Wt. 80 g. One stone.
81. Muroc, Kern Co., California. Stone. Found 1936 Sep. 20. Wt. 18.4 g. One incomplete stone.
82. Muroc Dry Lake, Kern Co., California. Stone. Found 1936 Sep. 20. Wt. 223 g. 2 stones.
83. New Leipzig, Grant Co., North Dakota. Iron. Found 1936. Wt. 20 kg. (44 lb.). One mass.
84. Karval, Lincoln Co., Colorado. Stone. Found 1936. Wt. 1104 g. One stone.
85. Plantersville, Grimes C., Texas. Stone. Found 1936. Wt. 2.08 kg. (4.6 lb.). One stone.
86. Crescent, Logan Co., Oklahoma. Stone. Fell 1936 Aug. 17, 7:07 P.M. Wt. 80 g. 2 stones.
87. Shafter Lake, Andrews Co., Texas. Stone. Found about 1933. Recognized 1936. Wt. approximately 6¼ lb. One stone.
88. Glen Rose, Somervell Co., Texas. Iron. Found about 1934. Recognized 1936. Wt. about 24½ lb. One mass.
89. Cuero, DeWitt Co., Texas. Stone. Found 1936 May 16. Wt. 46.5 kg. (102.5 lb.). One stone.
90. Kimble Co., Texas. Stone. Found 1918. Recognized 1936. Wt. 153.8 kg. (339 lb.). One stone, broken, the largest fragment, wt. 19.1 kg. (42.0 lb.).
91. Nordheim, DeWitt Co., Texas. Iron. Found 1932. Recognized 1936. Wt. 15.15 kg. (35 lb., 6 oz.). One mass.
92. Brownfield, Terry Co., Texas. Stone. Found 1937. Wt. 325 g. 2 stones.
93. Grady, Curry Co., Texas, No. 2. Stone. Found 1937. Wt. 9.3 kg. (20.5 lb.). One stone, broken.
94. Horse Creek, Baca Co., Colorado. Iron. Found 1937. Wt. 570 g. One mass.
95. Kelly, Logan Co., Colorado. Stone. Found 1937. Wt. 44.3 kg. (97.5 lb.). One stone.
96. Springfield, Baca Co., Colorado. Stone. Found 1937. Wt. 283 g. 2 stones.
97. Laketon, Gray Co., Texas. Stone. Found 1937. Wt. 3.6 kg. (8 lb.). 2 fragments.
98. Shaw, Lincoln Co., Colorado. Stone. Found 1937. Wt. 3.7 kg. (8.3 lb.). 2 fragments.

99. Arriba, Lincoln Co., Colorado, No. 2. Stone. Found **1937.** Wt. 0.5 kg. (1.1 lb.). One stone.
100. Somervell Co., Texas. Pallasite. Found about 1919. Recognized 1937. Wt. approximately 26 lb. 3 masses.

American Meteorite Laboratory, 1955 Fairfax Street, Denver, Colorado

Report of the Fifth Annual Meeting

The Fifth Annual Meeting, held in conjunction with the one-hundredth convention of the American Association for the Advancement of Science (Section D: Astronomy) and its Western Divisions, on June 22 and 23, 1937, at the Colorado Museum of Natural History, Denver, was the largest meeting, as regards both the number of members in attendance and the number of papers presented, in the history of the Society so far; in both of these respects it exceeded even the Fourth Meeting of 1936. The following twenty-seven members attended one or more of the scientific sessions, which were open likewise to the public and at which numerous visitors were present:

A. M. Bailey and W. F. Bingham (Denver), J. D. Boon (Dallas, Texas), L. F. Brady (Mesa and Flagstaff, Arizona), Robert Brown (Burleson, Texas), R. T. Chamberlin (Chicago, Illinois), C. E. Dietz (Cheyenne, Wyoming), R. D. Evans (Cambridge, Massachusetts), D. M. Gillespie and C. H. Hanington (Denver), H. W. Hixon (Avon Lake, Ohio), Lincoln La Paz (Columbus, Ohio), F. C. Leonard (Los Angeles, California), Harvey Markman (Denver), J. F. McCaffery (Masonville, Iowa), R. I. Meeker, Jr. (Denver), F. A. Melton (Norman, Oklahoma), H. A. Meyerhoff (Northampton, Massachusetts), O. E. Monnig (Fort Worth, Texas), Mrs. Addie D. Nininger and H. H. Nininger (Denver), E. C. Preston (Caldwell, Idaho), Alex Richards and Miss Julia L. Smead (Denver), L. R. Thiesmeyer (Cambridge, Massachusetts), A. P. Weaver (Newcastle, Wyoming), and R. W. Webb (Los Angeles, California).

Twenty-three papers, contributed from the United States, Australia, Czechoslovakia, England, India, and the U.S.S.R., were delivered, fourteen by their authors. Probably the most memorable feature of the meeting was the joint symposium on the afternoon of June 22 with Section E (Geology and Geography) of the Association, on the subject of meteoritic craters, in which a number of outstanding authorities, in both geology and meteoritics, participated. At this combined session, eight papers were presented, five personally by their authors. The program of the meeting and the list of papers follow.

PROGRAM OF THE FIFTH ANNUAL MEETING
President Frederick C. Leonard presiding

Tuesday, June 22

9:00 A.M.: Meeting of the Council (present, three members: the President, the Secretary-Treasurer, and Councilor L. F. Brady; and, by invitation, Secretary-nominate Robert W. Webb).

10:00 A.M.: Session for Papers, including (1) the Welcoming Address by Mr. Charles H. Hanington, President of the Colorado Museum of Natural History and a member of the Society; and (2) a Business Meeting, at which the revised Constitution and By-Laws (copies of which had been circulated with the call for the meeting) were unanimously adopted and so became the new governing instruments of the Society, and the Council for the quadrennium 1937-41 was elected.[1]

[1] See the announcement of the "Election of the Council and Appointment of the Publications Board for the Quadrennium 1937-41," in the *C.S.R.M.* in the August-September, 1937, issue of *P. A.*, p. 388.

The President named Dr. Lincoln La Paz, Mr. Oscar E. Monnig, and Mr. Ralph I. Meeker, Jr., to serve as the tellers for this election.

2:00 P.M.: Joint Session with Section E (Geology and Geography) of the A.A.A.S. for Consideration of the Subject of "Meteorite Craters." Dr. H. A. Meyerhoff, Secretary of Section E and a member of the Society, acted as secretary at this session, which convened in the auditorium of the School Administration Building, at Tremont and Fourteenth Streets; all the other sessions, of both the Society and the Council, were held at the Colorado Museum, in City Park.

Wednesday, June 23

9:00 A.M.: Meeting of the Council (present, three members: the President, the Secretary-Treasurer, and Councilor Brady; and, by invitation, Secretary-elect Webb). At this session, two Fellows and two Patrons of the Society were elected, under the revised Constitution and By-Laws.[2]

10:00 A.M.: Session for Papers.

2:00 P.M.: Session for Papers, concluding with the Retiring Address of the Outgoing President, the Report of the Secretary-Treasurer's Office (read by the Assistant Secretary), Brief Extemporaneous Reports by the Chairmen of the Committees on Terminology and Membership, *et cetera*. [The Committee on Terminology met formally as a committee in the evening of June 22. Two members of the Committee were present at this meeting, the Chairman (Dr. H. H. Nininger) and Mr. L. F. Brady, and also, by invitation, the President of the Society (Dr. F. C. Leonard), Dr. R. W. Webb, and Mrs. Addie D. Nininger.]

The combined collection of meteorites of Dr. Nininger and the Colorado Museum of Natural History was open for inspection during the entire time of the meeting. Opportunity was afforded for members to visit the shop of the American Meteorite Laboratory (known until recently as the Nininger Laboratory) in the recess period between the morning and afternoon sessions of June 23. The adjournment of the Fifth Meeting late in the afternoon of June 23, marked the end of the 1933-37 term, and the newly elected Council took office at that time.

The incoming Council held its first meeting, at which were present four members, the President (H. H. Nininger), the Secretary (R. W. Webb), the Treasurer (L. F. Brady), and Councilor (Ex-President) F. C. Leonard, immediately after the adjournment of the Fifth Annual Meeting of the Society. At this special session of the new Council, the two appointed members of the Publications Board and the Editor of the publications of the Society for the quadrennium 1937-41 were named.[1]

An informal dinner for members of the Society and their guests, attended by twenty-one persons, was held at 6:30 o'clock in the evening of June 23 at the Golden Lantern Inn, and concluded the program of the Fifth Annual Meeting.

LIST OF PAPERS READ AT THE FIFTH ANNUAL MEETING

1. THE QUESTION OF THE METEORITE OF JUNE 30, 1908, IN CENTRAL SIBERIA: *L. A. Kulik*, Lomonossoff Institute, Russian Academy of Sciences, Moscow, Russia (read by Robert W. Webb).

*2. THE NORFORK, ARKANSAS, METEORITE, AN IRON OF WITNESSED FALL: *H. H. Nininger*, Colorado Museum of Natural History and American Meteorite Laboratory.

[2] See the announcement entitled "Election of Fellows and Patrons at the Fifth Annual Meeting," in the *C.S.R.M.* in the August-September, 1937, issue of *P. A.*, p. 388.

*3. Observations Pertaining to the Times of Meteorite Falls: *Ralph I. Meeker, Jr.*, Denver, Colorado.

*4. Frequency and Distribution of Recorded Meteorite Falls: *Miss Julia Lola Smead*, Colorado Museum of Natural History.

5. The Composition of Meteoritic Iron Sulphide: *John Davis Buddhue*, Pasadena, California (read by L. F. Brady).

*†6. A Summary of the Findings Resulting from the Exploration, the Geophysical Survey, and the Test Drillings at Meteorite Crater, Arizona: *W. F. Bingham*, U. S. Bureau of Reclamation, Denver, Colorado.

*†7. Geological Theories on the Origin of the Carolina Bays: *Frank A. Melton*, University of Oklahoma.

†8. Meteorites and the Craters on the Moon: *Leonard J. Spencer*, Formerly Keeper of Minerals, British Museum of Natural History, London, England (read by H. H. Nininger; as this paper was published in full in *Nature*, **139**, 655, Apr. 17, 1937, it will not be reprinted in the *C.S.R.M.*; it was contributed by invitation to the program of this meeting).

*†9. Observations during the Excavation of a Meteorite Crater: *H. H. Nininger.*

*†10. Meteorite Craters and Structures: *Claude C. Albritton, Jr.*, and *J. D. Boon*, Southern Methodist University (read by the second author).

*†11. On the Concepts of Earth Shells: *R. T. Chamberlin*, University of Chicago.

†12. Age Determination of Meteorites: *W. D. Urry*, Massachusetts Institute of Technology (read by Robley D. Evans).

†13. Meteorite Contributions to Sediments: *Alfred C. Lane*, Cambridge, Massachusetts (read by H. A. Meyerhoff).

*14. Meteorite Discoveries Reported to the Society for Research on Meteorites, August, 1933, to June, 1937: *Mrs. Addie D. Nininger*, American Meteorite Laboratory.

15. The Oxidation of Meteorites: *John Davis Buddhue* (read by L. F. Brady).

*16. An Unusual Oxidized Mass of Canyon Diablo, Arizona, Iron: *L. F. Brady*, Mesa Ranch School and Museum of Northern Arizona.

17. Czechoslovakian Tektites and the Problem of their Origin: *Jan Kaspar*, Narodni Museum, Praha, Czechoslovakia (the manuscript of this paper arrived too late to be read in full at the meeting; so it was read instead by title).

18. Australites: Are they Glass Meteorites?: *Charles Fenner*, University of Adelaide, South Australia (read by L. F. Brady).

19. Comparison of Meteorite Falls during A.M. and P.M. Hours: *Mohd. A. R. Khan*, Osmania University College, Begumpet, Deccan, N.S.R., India (read by Miss Julia Lola Smead).

*20. The Determination of the Age of Iron and Stony Meteorites from their Radioactivity: *Robley D. Evans*, Massachusetts Institute of Technology.

*21. Meteorite Distribution Problems: *Lincoln La Paz*, Ohio State University.

*22. Announcing the Establishment of the American Meteorite Laboratory: *H. H. Nininger.*

*23. The Report of the President of the Society for the Term 1933-37: *Frederick C. Leonard*, University of California at Los Angeles.

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*Papers marked by an asterisk were presented personally by their authors.

†Papers numbered 6 to 13 inclusive were those delivered at the joint symposium of the Society and Section E (Geology and Geography) of the A.A.A.S., held on Tuesday afternoon, June 22, on the general topic of "Meteorite Craters."

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By LEON CAMPBELL, Recorder

The Light Curve of U Cygni: In volume 33 of the *Memoirs* of the British Astronomical Association there has recently appeared a lengthy and detailed discussion by Dr. J. van der Bilt, of the Utrecht Observatory, on the N type red variable star, U Cygni, 201647. The study is based on about forty-two hundred observations covering the years 1907 to 1935, made by the members of the Variable Star Section of that Association.

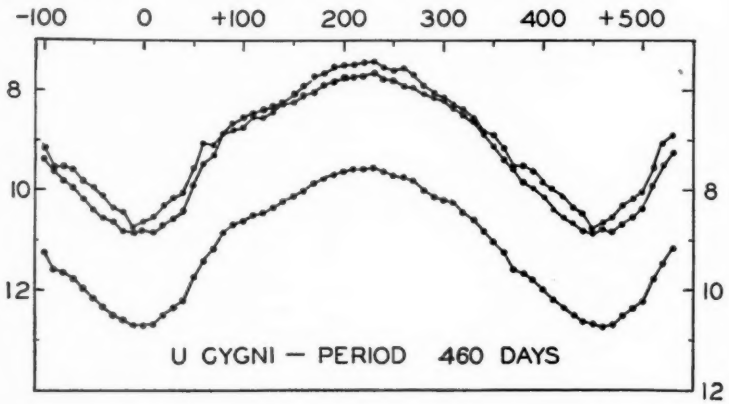
Dr. van der Bilt has done what has long been considered a very much needed task—the reduction of all the observations to the basic scales of two particular observers, Dr. Felix de Roy and Mr. A. N. Brown. These observers were chosen because they had observed the star over practically the entire period under discussion and had made the greatest number of individual observations. While it had been the hope of the author to eliminate all "personal" difficulties and reduce to the "normal eye," he admits that this was not possible. Though the resulting curves are strictly homogeneous, they are nevertheless still "personal," representing the personal equations of the standard observer. All the observations were ultimately published and illustrated on the basic scale of de Roy.

The appendix to the volume contains all the B.A.A. observations, tabulated first on the system of the individual observers, and second, reduced to the scale of de Roy. Diagrams are given showing the difference between each observer's scale and that of de Roy. The diversity in form clearly indicates the wide systematic differences existing among various observers. Explanations of these divergences are still lacking; they are doubtless involved in physiological as well as psychological causes. The final plate of the volume represents the smoothed light curve for the entire interval of time, 1907-1935, reduced to the basic curve of de Roy.

It has long been the claim of the Recorder that, if a large number of observations of such red stars as U Cygni, R Leporis, S Cephei, and others, are made by many observers, over the entire light curve, by a uniform method, the deduced curve would represent to a remarkable degree of accuracy the general behavior of these stars. More than 5500 observations of U Cygni, covering these same years, have been made by observers at Harvard prior to 1911, and by A.A.V.S.O. observers subsequent to that date. These observations yield an abundance of material for testing the reliability which can be placed upon the use of observations combined into light curves without an elaborate analysis.

A comparison of the B.A.A. light curves, corrected and uncorrected, with the H.C.O.-A.A.V.S.O. uncorrected curves, shows some interesting results. The uncorrected curves are remarkably similar in form throughout, especially from the year 1912 on, when the observations by the A.A.V.S.O. were more numerous. The largest divergence appears on the ascending branch of the curves and at, or near, minimum phase. As is to be expected, the B.A.A. corrected and the H.C.O.-A.A.V.S.O. uncorrected curves show greater differences, although here again the agreement is exceeding close from 1926 on. The presence of the customary "still-stand" on the ascending branch of the curve is particularly uniform and similar in both curves.

Mean light curves derived from the B.A.A., corrected and uncorrected, and the H.C.O.-A.A.V.S.O. uncorrected data, do not differ markedly. The light curve obtained by combining the uncorrected data from both sources differs only slightly from that derived from the B.A.A. corrected magnitudes. A change of about two-tenths of a magnitude is required to bring the curves into practical agreement, the B.A.A. corrected curve being, in general, the fainter, especially at maximum and minimum phases. A diagram of the separate curves, uncorrected and corrected, is given in the two upper figures; the combined curves appear below.



As a conclusion, it may be stated that Van der Bilt's statement "that, provided the number of observers be large and their individual observations evenly distributed, a mean light curve drawn through all the observations would not differ markedly from one yielded by a complete analysis," is well borne out. With the two variable star associations working together, it looks as if a knowledge of the future behavior of U Cygni is assured.

Variable Stars at the A.A.S. Meeting: At the Williamstown meeting of the American Astronomical Society held September 8 to 11, relatively few papers dealing with the light variation of stars were presented. Nevertheless, those few were of real value and keen interest.

Irregular Variables: Dr. C. M. Huffer described his work with the photoelectric photometer on a few of the irregular variables so popular with the A.A.V.S.O. observers. His curves of R Coronae Borealis and R Scuti closely followed those derived from strictly amateur observations, thus giving added confidence in the results so far obtained. VV Cephei and Gamma Cassiopeiae were included in Huffer's program, the present rise from minimum of the former and the decrease from maximum of the latter, being well determined. Gamma Cassiopeiae had faded by August 23 from a maximum magnitude of 1.7 to a minimum value of 2.1, its original magnitude.

RZ Cassiopeiae, Eclipsing Variable: Dr. J. S. Pearce described the action of the eclipsing variable RZ Cassiopeiae, and showed the existence of a secular term of 17.5 years in the rotation of the line of apsides.

Variables in Messier 3: Dr. A. H. Joy referred to his work on some of the bright variables in the well-known cluster Messier 3. He had studied in particu-

lar Barnard's variable in that cluster, and cited a period of 15.28 days with a range in magnitude from 12.9 to 14.0. The light curve resembles that of X Cygni.

Classification of Variables in the Great Sequence: One of the papers read by Dr. S. Gaposchkin described his work on the asymmetry of the light curves in the Great Sequence as a function of the period. He used a method of classification of the cluster type, Cepheid, and long-period variables which gave results not vastly different from the methods used by Ludendorff and Campbell, but with results of a more quantitative nature. Attention was called to the maximum and minimum period frequency, such as occur at $0^d.1$ and $0^d.5$, for cluster type stars, $5^d.0$ and $10^d.1$ for Cepheids, 85 days for semiregular variables, and 320 days for long-period variables. Minimum values occur at periods of about $0^d.2$, $1^d.6$, 9 days, 50-60 days, and possibly about 600 days. At the minimum of period frequency the light curves show the greatest irregularities. Dr. Gasposchkin's other paper dealt with the variations of VV Cephei, already referred to in these notes for April, 1937.

The Multiple Variability of 12 Lacertae: E. A. Fath mentioned another photo-electric attack on variable stars, Delta Scuti and 12 Lacertae. Both variables were found to present widely different forms of light curves from night to night, and he has been able to satisfy such variations in form by assigning periods for the change in amplitude: $5^d.25$ for Delta Scuti and $7^d.5$ for 12 Lacertae. The periods of the normal light variation are of the order of $0^d.2$. This result opens up a new problem in the variation of short-period variables, suggestive of the variation in form of light curve noted in the planet Eros. Dr. Fath stated that Delta Scuti and 12 Lacertae also showed variations in amplitude of the velocity curve.

The Higher Modes of RR Lyrae: Dr. T. E. Sterne presented his results of the search for the higher modes of RR Lyrae, the cluster type variable which has been long known to vary considerably at different maxima, both in time of occurence and in form of light curve. With a mean period of $0^d.567$, and with a longer period of 38.2 days over which the star appears to change, two short periods may be active at once. Dr. Sterne emphasized the need for considerable observational material distributed over the entire light curve, and on consecutive nights, if possible. Dr. Sterne has not yet been able to explain the complete light curve by a combination of any two periods equal to $0^d.567$ or less, since no pair of periods that he has tried has fitted both the photographic and visual observations.

Minimum of R Scuti: The recent minimum of R Scuti, magnitude 7.0, was quite completely observed by the A.A.V.S.O. observers. The last previously-observed minimum which approached this depth was that observed in July, 1932, when the star attained magnitude 7.2. Other exceptionally deep minima occurred in October, 1927, magnitude 8.2, and in August, 1921, magnitude 7.7.

Two Super-Novae: Two more super-novae have been discovered in distant galaxies recently by Dr. F. Zwicky of the Mount Wilson Observatory. The first, in the galaxy I.C. 4812, was reported as of magnitude 8.5 on August 28. It was not visible on May 31, but appears on several later plates. The second nova appeared in N.G.C. 1003, in the constellation Perseus, and was discovered on September 10. The magnitude was estimated as 10.5 by Dr. Zwicky. The Nova is the southern component of a pair of stars of nearly equal brightness, the Nova being slightly the brighter, as observed visually with the Harvard 15-inch equatorial on September 14. The visual magnitude, estimated to be about 12.5, did not differ radically from the photographic magnitude found on the Harvard plates.

New Observers: The following are new observers during July and August: Mr. L. N. Carapiperis, of the National Observatory, Athens, Greece; Miss Mary Ellison, of Webster Groves, Missouri; Mr. Clifford Seauvageau, of Detroit, Michigan; and Mr. Louis Spelman, of Silver Bay, New York.

Observer	July Vars.	July Obs.	August Vars.	August Obs.
Ahnert	38	239	..	..
Ancarani	..	..	9	32
Baldwin	98	199	115	235
Ballhaussen, Miss	6	6	10	11
Bappu	27	63	..	..
Blunck	55	71	60	78
Brown, S. C.	20	20	..	..
Buckstaff	12	48	14	43
Callum	29	40	50	173
Cameron	5	5	10	12
Carapiperis	..	..	34	71
Carpenter	149	149	148	153
Chandra	151	248	..	..
Chartier	55	114	..	..
Cousins	16	64	..	..
Crout	9	19	6	7
Dafter, Mrs.	8	19	5	16
Dalton	5	7	..	..
Diedrich	2	6	2	10
Ellis	31	43	52	125
Ellison, Miss	..	..	3	3
Ensor	50	172	..	..
Evans	..	..	10	22
Fairbanks	8	13	6	15
Fernald	4	14	6	23
Focas	99	173	70	117
Franklin	..	..	16	22
Friton	..	..	3	8
Gregory	110	196	65	92
Halbach	..	..	2	2
Hamilton	..	..	7	12
Hartmann	68	86	110	245
Herbig	71	270	70	167
Hiett	17	27	14	35
Hildom, A.	21	65	16	18
Holt	22	27	16	16
Houghton	61	152	..	..
Houston	81	203	73	259
Howarth	15	17	14	17
Jones	85	352	100	363
King	4	5	4	5
Kirkpatrick	23	90	20	89
Kitchens	4	5	6	13
Knott	..	..	5	10
de Kock	41	170	40	135
Koons	23	25	..	..
Kozawa	14	37	..	..
Loreta	99	206	105	300
Millard	27	67	29	113
Mitchell, R.	23	50	23	30
Murphy	20	59	8	10
MacCalla	..	..	6	6
McLeod	15	20	18	40
McNabb	1	4	..	..
Northcott, Miss	..	..	4	4
Peltier	172	196	184	236
Purdy	4	6	..	..
Rosebrugh	20	39	17	92
de Roy	11	30	13	36
Russell, J.	10	10	22	46
Ryder	6	6	..	..
Schattle	1	5	..	..
Seauvageau	6	8	..	..
Seely	4	11	6	29
Segers	5	28	..	..
Shafer	3	12	..	..
Shultz, Miss	15	15	16	16
Sill	34	37	26	26
Smith, F. P.	25	32	30	40
Smith, F. W.	1	2	2	4
Smith, J. R.	33	40	27	27
Smith, L.	8	8	..	..
Spelman	..	..	5	5
Topham	9	11	8	12
Treadwell	7	22	14	30
Watson	18	32	..	..
Webb	33	35	26	26
Woods	13	40	18	31
Yamasaki	7	8	8	9
	79	4498		3822

September 16, 1937.

Notes from Amateurs

Aurora Borealis Observed

An unusual display of Aurora Borealis was visible in Akron, Ohio, on the night of August 1-2. I first noticed the phenomenon about 12:30 A.M. The long streamers, resembling searchlight beams, which we first noticed, arose from a low curtain-like effect which covered the entire northern heavens. This curtain was sharply terminated on the lower edge about 15° above the horizon and was cut in several places by dark lanes. The streamers radiated for the most part from the

region around Capella. They seemed to shoot up towards the zenith for 20° or 30° and then drift eastward for 2 or 3 minutes at a rate of approximately 5° per minute. At about 1:30 A.M. a bright arch appeared. It ran entirely across the sky, passing about 5° south of Vega. It appeared as though drawn with a radius of about 50° from a point about 15° from the pole star.

Y. M. C. A., Akron, Ohio, August 5, 1937. RICHARD T. WINDSOR.

Amateur Astronomical Society of Los Angeles

The Amateur Astronomical Society of Los Angeles went on its annual excursion to the Mt. Wilson Observatory on August 7-8, 1937. Through the courtesy of Dr. A. H. Joy the 60-inch reflector was made available to the members of the Society in the evening.

The group gathered at 7:30 in the Astronomical Museum, which contains a wonderful series of transparencies, and from there proceeded to the 60-inch dome. Dr. J. O. Hickox showed us Mars, Jupiter, the Hercules Cluster, and the Ring Nebula. At about 10:30, the group left the telescope, and observing with three small telescopes belonging to members continued until after midnight, by which time the majority had either returned to the city, or had gone to their cabins.

The sky being very clear, two members observed the Perseids with a 6-inch reflector until sunrise. An averaged count of Perseid meteors showed one about every two minutes. The air was extremely transparent, Messier 33 being clearly visible to the unaided eye.

The next morning we watched Dr. Hickox make a series of spectroheliograms in hydrogen and calcium light with the 60-foot solar tower telescope. Later, with the 150-foot tower, he showed us the D-lines of sodium with high dispersion in the long-focus spectroscope. Between the two lines, thirteen fainter ones were seen. The spectrum of a sunspot, showing the magnetic shift, the bright line of helium in the chromosphere, and the hydrogen and calcium lines were also exhibited.

Later we went to the dome of the 100-inch reflector, and Dr. Hickox showed us the tank in which the large mirror had been aluminized, and the driving mechanism with its 17-foot worm wheel, besides the usual exhibition of the telescope itself.

The Society extends the warmest thanks to Drs. Joy and Hickox for the many courtesies shown us.

GEORGE HERBIG.

2606 W. 8th Street, Los Angeles, California, August 12, 1937.

General Notes

Dr. M. Minnaert, formerly observer at the Physics Institute at the University of Utrecht, has been appointed Professor of Astronomy and Director of the Observatory as the successor to Professor A. A. Nijland. (*A.N.*, No. 6298.)

Dr. Frederick C. Leonard, Chairman of the Department of Astronomy of the University of California at Los Angeles and Ex-President of the Society for Research on Meteorites, lectured on meteorites before the Vancouver Center of the Royal Astronomical Society of Canada on the evening of August 10, 1937, and before the Victoria Center on the night of August 23. The first lecture was given on the campus of the University of British Columbia and was open to the summer

session of the university, in which Dr. Leonard was visiting professor of astronomy. The second was delivered at Victoria College, an affiliated institution of the University of British Columbia.

Dr. Samuel Herrick, Jr., who received his Ph.D. degree in astronomy from the University of California, Berkeley, in December, 1936, has been appointed an instructor in the Department of Astronomy of the University of California at Los Angeles. Dr. Herrick will teach mainly courses in practical and mathematical astronomy. During the spring quarter of 1937, Dr. Herrick served as visiting instructor in the Department of Astronomy of the University of Washington at Seattle.

Astronomy at the Paris Exposition

In the Grand Palace which has been transformed into a "Palace of Discovery" for the period of the Exposition an extensive astronomical exhibit has been installed. A series of rooms and galleries having a mural surface of some 2000 square meters is devoted to this exhibit. Great care has been taken by those in charge of arranging the exhibit to have the modern phases of astronomy presented. Apparatus of various kinds is set up to be operated by the visitors, and a demonstrator is available to answer questions. The exhibits are classified as follows: General, Stellar Universe, Sun, Moon, Planets, Comets and Meteors, Astronautics, Observatories and Instruments.

Asteroid Numbers, Early and Modern

Sir William Herschel would find recent estimates of the number of the asteroids highly gratifying. The two quotations which follow tell the story. The first is contained in a letter from Thomas Campbell to a friend in 1813, quoted on pages 335-6 of "The Herschel Chronicle" by Constance A. Lubbock.

"He [Herschel] was convinced that there had existed a planet between Mars and Jupiter, in our own system, of which all little Asteroids or planetkins, lately discovered, are indubitably fragments; and 'Remember,' said he 'that though they have discovered only four of those parts, there will be thousands—perhaps 30,000—more not yet discovered.'"

The second forms part of an article by W. Baade in the February, 1934, issue of the *Proceedings of the Astronomical Society of the Pacific.*

"For the total number of asteroids observable with the 100-inch telescope at opposition we therefore have . . . 44,000. The order of magnitude here derived is in good agreement with an independent estimate kindly put at my disposal by Dr. Hubble. . . . he estimated the total number observable with the 100-inch as of the order of 30,000."

Mr. Abraham Oshinsky, 167 Sands Street, Brooklyn, New York, is eager to form a group in his neighborhood for the study of astronomy. Anyone interested in such a project should communicate with him.

Correction.—On page 358 of the preceding issue in the sixth line of the paper entitled "Observations near the Noon Point of the 1937 Eclipse" the longitude of the point of observation is erroneously given. The longitude was 133 degrees 38 minutes West instead of 130 degrees 38 minutes West, as stated.

Asteroid Notes

By HUGH S. RICE

For this month the asteroids Pallas and Ceres are the most easily observable, among the larger ones. Pallas will be in western Aquila, with a brightness of $9^{M}.8$. Ceres is in the northwest corner of Piscis Austrinus in the middle of the month, at $8^{M}.3$. We are giving herewith ephemerides of these planets, as computed by the world's headquarters, the Astronomisches Rechen-Institut.

One of the more uncommon asteroids, Amphitrite, a chart of which was published in the last issue of this magazine, has been following its apparent path excellently; and the chart is still good until well into November. The object is in Aquarius, and between 9th and 10th magnitudes.

A minor planet which had much attention formerly, when it was supposed to be the nearest one to the earth, but which does not now have even second place among our asteroids that can come near us, is Eros. This small world will make another visit "near" the earth at the end of this year and the beginning of next. An ephemeris was computed by Meyer of Rutherford, with the result that the planet is found to perform a loop in the north circumpolar heavens in Perseus and Camelopardalis. On October 12 it passes immediately to the east of λ Persei; its magnitude then is 9.9. Eros comes to opposition early in December, and in January it makes its closest approach to us—something under 20,000,000 miles. We expect to give ephemerides or else a chart of its path, so that observers can find it easily with small telescopes.

ASTEROID EPHEMERIDES. FOR 0^{h} G.C.T. EQUINOX 1925.0

	2 PALLAS			1 CERES	
	α	δ		α	δ
	h m	° ′		h m	° ′
Oct. 6	18 56	+6 26	Oct. 6	21 32	−28 23
14	19 1	5 9	14	21 32	27 56
22	19 7	3 59	22	21 33	27 21
30	19 13	2 57	30	21 36	26 41
Nov. 7	19 21	+2 2	Nov. 7	21 40	−25 54

Hayden Planetarium, American Museum of Natural History,
New York, September 24, 1937.

Book Review

Am Fernrohr, by Dr. Friedrich Becker. (Ferd. Dümmlers Verlag, Berlin and Bonn, Germany. 2½ marks.)

The above title (At the Telescope) is given to a brochure of 48 pages. It is described as a guide for the study of the heavens with unaided eye and with small instruments. A chapter is given to each of the following topics: Constellations, Stars of the first four magnitudes, Double Stars, Variable Stars, Star Clusters, Nebulae, The Milky Way, The Moon and Planets.

It is well printed, well illustrated, and contains much information in a small space. The text, naturally, is in German, but the charts and the tables are intelligible even if one is not familiar with the German language. It is a useful reference work for any beginner in the study of astronomy. C.H.G.

POPULAR ASTRONOMY

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